

THE FUTURE OF AGRICULTURE

Synthesis of an online debate



Mr Neang Veach and Ms Yorn Yee, farmer and SRI instructor. Yorn offers guidance in the SRI (System of Rice Intensification) agricultural system. Photo: Jim Holmes/Oxfam.

Fear that global demand for food will outstrip supply has sparked much handwringing and significant debate. To get beyond the question of securing steady supplies for food and beverage companies, and to rise above polarized discourses on large-scale industrialized vs. smallholder farms, in December 2012 Oxfam hosted a two-week online discussion on the future of agriculture. The debate formed part of Oxfam's efforts to develop a creative and positive vision of food production that can ensure everyone has enough to eat always. This paper offers a synthesis of the online debate, the 23 essays by experts from 16 countries that formed the basis of the discussion, and Oxfam's concluding remarks.

Oxfam Discussion Papers

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ABBREVIATIONS

AHBFI	Africa Harvest Biotech Foundation International
BEA	Biodiversity-based ecological agriculture
BNPS	Bangladesh Nari Progati Sangha
CEO	Chief executive officer
CHIRAPAG	Centre for Peru's Indigenous Cultures
ETC group	Action group on Erosion, Technology and Concentration
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration
FFL	Farmer First and Farmer Last
GM	Genetically modified (crops)
HEI	High external input (agriculture)
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
IFAD	International Fund for Agricultural Development of the United Nations
IFPRI	International Food Policy Research Institute
ILC	International Land Coalition
ILO	International Labour Organization (of the United Nations)
INHERE	Institute of Himalayan Environmental Research and Education
LEI	Low external input (agriculture)
NGO	Non-government organization
PNPB	Programme for the Production and Use of Biodiesel
RIMISP	Latin American Centre for Rural Development
USAID	United States Agency for Development Aid
UN	United Nations

1 INTRODUCTION

The fear that the world will not be able to satisfy global demand for food has sparked much handwringing and significant debate on 'How and who to feed the world'. More often than not, the goal of ending hunger and poverty is obscured by that of securing steady supplies for large food and beverage companies. And even when it is not, the debate rarely rises above polarized discourses on large-scale industrialized agriculture versus smallholder agriculture or High External Input (HEI) production systems versus Low External Input production systems (LEI).

In December 2012, Oxfam's Future of Agriculture project hosted a two-week online discussion as part of Oxfam's efforts to develop a creative and positive vision of a food system (from seed to fork to waste and back) that ensures everyone has enough to eat always. The online debate featured essays by 23 experts from 16 countries and the participation of hundreds of interested parties from around the globe. The debate was carried on more than 30 websites and blogs worldwide.

The essayists were asked to answer one of the following questions:

- *What if* all farmers had adequate risk management systems to deal with climate trends and shocks, as well as with price volatility in input and product markets?
- *What if* fossil fuels were no longer required in any form of input to global agricultural production?
- *What if* all farmers, male and female, had full and equal control over the necessary resources for farming, and over the outputs of their labor?
- *What if* the ideas and innovations of resource-poor farmers leading to improvements of their natural resource base were supported by adequate access to public and private sector investments?

This paper offers a synthesis of the points of view expressed by contributors and commentators, an appendix with all 23 essays, as well as brief concluding remarks by Oxfam. In the text the names of the authors of the essays that are found in the appendix are in bold for easy reference. Our thanks go to the contributing experts and to the more than 300 persons who took part in the online debate.

2 RISKY BUSINESS

Two things distinguish food production from nearly every other productive activity: first, every single person needs food every day and has a right to it; and second, it is hugely dependent on nature. These two unique aspects, one political, the other natural, make food production highly vulnerable and different from any other business. At the same cultural values are highly entrenched in food and agricultural systems worldwide.

Farmers worldwide face major risks, including extreme weather, long-term climate change, and price volatility in input and product markets. Smallholder farmers in the developing world must in addition deal with adverse environments, both natural, in terms of soil quality, rainfall, etc, and human, in terms of infrastructure, financial systems, markets, knowledge and technology. Counter-intuitively, hunger is prevalent among many smallholder farmers in the developing world; they are net food consumers.

Participants in the online debate argued that our biggest challenge is to address the underlying causes of the agricultural system's inability to ensure sufficient food for all, and they identified as drivers of risk our dependency on fossil fuels and unsupportive government policies.

On the question of mitigating the risks farmers face, most essayists called for greater state intervention. In his essay **Kanayo F. Nwanze**, President of the International Fund for Agricultural Development (IFAD), argued that governments can significantly reduce risks for farmers by providing basic services like roads to get produce more efficiently to markets, or water and food storage facilities to reduce losses and stabilize prices. **Sophia Murphy**, senior advisor to the Institute for Agriculture and Trade Policy, suggested that the procurement and holding of stocks by governments can also help mitigate wild swings in food prices by alleviating uncertainties about market supply.

Shenggen Fan, Director General of the International Food Policy Research Institute (IFPRI), held up social safety nets and public welfare programs like Ethiopia's Productive Safety Net Programme, Brazil's *Bolsa Familia*, and Mexico's *Oportunidades* as valuable ways to address poverty among farming families and reduce their vulnerability to agricultural shocks. Some commentators responded that cash transfers to poor families do not necessarily translate into increased food security as these programs do not always strengthen food production or raise incomes.

Regarding state subsidies for agriculture, **Rokeya Kabir**, executive director of Bangladesh Nari Progati Sangha (BNPS) commented in her essay that these "*have not compensated for the stranglehold exercised by private traders. In fact, studies show that sixty percent of beneficiaries of subsidies are not poor, but rich landowners and non-farmer traders.*"

Nwanze, **Murphy** and **Fan** argued that private risk management tools, like private insurance, commodity futures markets, and rural finance, can help small-scale producers mitigate risk and allow for investment in improvements. **Kabir** warned that financial support schemes often encourage the adoption of high-input agricultural practices, which in the medium term may raise production costs beyond the value of their harvests. **Murphy** noted that when futures markets become excessively financialized they can contribute to short-term price volatility, which exacerbates farmers' food insecurity. Many participants and commentators emphasized that greater transparency in markets is needed to mitigate the impact of volatility, and make evident whether adequate stocks and supplies are available. Others contended that agribusiness companies should be held responsible for paying for negative externalities.

Many essayists mentioned climate change and its consequences for small-scale agriculture. **Fan** explained that "*in addition to reducing crop yields, climate change increases the magnitude and the frequency of extreme weather events, which increase smallholder vulnerability.*" The

growing unpredictability of weather patterns increases farmers' difficulty in managing weather-related risks. According to this author, one solution would be to develop crop varieties that are more resilient to new climate trends and extreme weather patterns. Accordingly, **Pat Mooney**, co-founder and executive director of the ETC Group, suggested that "*if we are to survive climate change, we must adopt policies that let peasants diversify the plant and animal species and varieties/breeds that make up our menus.*"

Some participating authors and commentators argued in favour of community-based and autonomous risk management strategies through *collective action groups*, *cooperatives* or *producers groups*. Such groups enhance market opportunities for small-scale producers, reduce marketing costs and synchronize buying and selling with seasonal price conditions. According to **Murphy**, "*collective action offers an important way for farmers to strengthen their political and economic bargaining power, and to reduce their business risks.*" One commentator (Giel Ton) warned that *collective action does not come as a free good. It takes time, effort and money to organize, build trust and to experiment.* Others, like Marcel Vernooij and Marcel Beukeboom, suggested that in order to "apply what we already know" all stakeholders, including business, government, scientists and civil society, must work together, starting at the beginning of the value chain.

Some participants explained that market price volatility is often worsened by the presence of intermediary buyers who, taking advantage of farmers' vulnerability, dictate prices. One commentator suggested farmers can gain greater control over prices and minimize price volatility by selling directly to consumers. Similarly, **Sonali Bisht**, founder and advisor of INHERE, India, wrote that community-supported agriculture, where consumers invest in local farmers by subscription and guarantee producers a fair price, is a risk-sharing model worth more attention. Direct food distribution systems not only encourage small-scale agriculture but also give consumers more control over the food they consume.

Prakash-Mani, Head of Food Security Agenda at Syngenta International, **Nwanze** and **Murphy** all posit the need for more affordable insurance systems to protect farmers against climate and market-related risks. **Murphy** notes that new experiments with insurance in the developing world such as Oxfam's insurance scheme in Ethiopia with Swiss Re, the World Food Program and USAID (R4 Rural Resilience Initiative) and the ILO (International Labour Organization)/Gates Foundation insurance program for small-scale producers in Bolivia have shown success. One commentator called for support to community-based insurance systems, an alternative risk management approach that mobilizes local resources and promotes equity through risk sharing and pooling of local funds.

3 FUELS ON THE FARM

With climate change, resource scarcity and changing consumption patterns, concerns about agriculture's dependence on fossil fuels have risen up the policy agenda. Large proportions of the scientific community, the UN and the World Bank (ref IAASTD, 2009) as well as a growing number of consumers have called for a shift toward greener, more diverse and eco-friendly agricultural systems. For at least 4,000 years farmers have been innovating organic techniques to protect crops, combat pests, develop better varieties and improve the soils. The widespread use of synthetic pesticides and fertilizers dates only from the beginning of the last century.

Despite the Green Revolution, which by now has been acknowledged by many as having been not very green, since the 1960s pesticide and chemical use in agriculture has been hotly debated (see, e.g. Oxfam's report 'Who Will Feed the World?', 2011).

In the Oxfam online debate almost all participants agreed on the need to reduce the use of fossil fuels in agriculture. Only **Prem Bindraban**, Director of ISRIC (World Soil Information), and **Harold Poelma**, Managing Director of Cargill Refined Oils Europe, are convinced that fossil fuel will remain indispensable to ensure global food security for an ever-growing population. Some participants took a middle-ground position by arguing for the need for both low- and high-input agriculture (**Ambler**, Vice-President for Strategy at Oxfam America, and **da Silva**), while others, including **Anna Lappé**, founding principal of the Small Planet Institute, **Sarojeni V. Rengam**, Executive Director of Pesticide Network Asia and the Pacific, and **Bill McKibben**, founder of 350.org) strongly argue for a more ecological sound approach. As **Sonali Bisht** concluded in her summary essay: *"Most participants made clear how our present agricultural system is highly dependent upon the use of fossil fuels and how this dependency is created and maintained by the political power of the fossil fuel industry and the lobbying clout of agribusiness"*.

José Graziano da Silva, Director General of the Food and Agriculture Organisation of the United Nations (FAO), explained that the agricultural and energy markets have become closely intertwined over time as agricultural productivity has increased through mechanization, fertilization, and increased trade. Agriculture contributes more than any other industry to greenhouse gas emissions (**McKibben**). Globally, the agro-food chain utilizes 30 percent of the world's available energy, while 70 percent of that is used after the farm gate (**da Silva**). On the farm, fossil fuels contribute significantly to inputs both directly to power tractors and farm equipment, as well as indirectly in the form of chemical fertilizers and pesticides. Nitrogen and phosphorous – two key elements found in non-organic fertilizers – require enormous volumes of natural gas to be synthesized. In some countries, like China, these industrial transformations are powered by dirty coal (**Lappé**). After the farm gate, fossil fuels are used intensively for transport of agricultural commodities and food processing. Commentator Gordon Wagner from Food Security Strategies argued that insofar as the world becomes ever more dependent on the inputs of high-tech firms like Monsanto, the world will become more food insecure.

Three of the essayists (i.e., **Nwanze**, **Bindraban**, and **da Silva**) mentioned the use of alternative energy, such as domestic biogas, as a way to reduce agricultural dependency on fossil fuels. Biogas, a mixture of methane and carbon dioxide produced through anaerobic (in the absence of oxygen) digestion of organic matter by bacteria, allows farmers to generate energy for their homes and farms from agricultural, human and animal waste. Biogas not only produces a cheap and environmentally friendly fuel, but it also solves the problem of waste management, a major contributor of greenhouse gas emissions when methane is liberated into the atmosphere. However, the production of biogas may undermine sustainability if organic waste is primarily used for fuel rather than to fertilize crop production.

Da Silva argued that the production of biofuels may have the potential to improve income for producers and net-sellers of agricultural commodities, but that these tend to be larger and richer producers and the price risks are often borne by the most vulnerable consumers. This is so even in the cases where attempts have been made to produce agrofuels in more sustainable ways and with the participation of small-scale family farmers, as in the case of Brazil's National Programme for the Production and Use of Biodiesel (PNPB) (see Manzi 2013).

Anna Lappé wrote that we should all feel a sense of urgency and hope in transitioning towards a fossil-fuel free agricultural system: *"We know how to farm without such a heavy reliance on fossil fuels and we know the freedom it brings from corporations' monopoly control over industrial inputs like pesticides, genetically engineered seeds, and fertilizer"*. **Sarojini V. Rengam** argued that since the biggest challenge in reducing fossil fuel use in agriculture is transport, opting for more local food is the most direct way to tackle this problem. In addition, **da Silva** suggested that *"fossil fuel use can be directly reduced by changes in tillage practices which not only cut energy use, but may reduce greenhouse gas emissions by capturing carbon in the soil and may reduce crop losses from drought events."*

Bill McKibben stated that *"one problem with what we now call conventional farming (in fact, it's the convention only of the last half-century, and a radical break with the 10 millennia that proceeded it) is that you're constantly degrading soils as you turn them into a matrix for holding petroleum-based fertilizer. By contrast, low-input systems get better over time, partly because the soil improves but also because farmers stop relying on the rote advice of chemical companies and start paying attention to their fields."* One such low-input system is what **Rengam** refers to as Biodiversity-based Ecological Agriculture (BEA), which aims to conserve biodiversity and reinforce ecological principles that are suitable for local ecosystems. BEA builds on local and indigenous knowledge to increase soil fertility by using agro-ecological practices such as crop rotation, integrated pest management, the conservation of traditional crop varieties and the breeding of higher yielding, more nutritious and stress-resistant varieties.

In her essay entitled *"Why eat oil when we could eat sunlight?"*, **Lappé** mentioned that organic methods can use as much as 45 percent less energy than industrial methods. She argues that, while sustainable farming practices help protect biodiversity and promote soil conservation, clean water, and other ecological benefits, yields are often as high—or higher—than farms that rely on chemical inputs. Corroborating this statement, **McKibben** cited the United Nations Environment Programme that yields across Africa *"doubled or more than doubled where organic or near-organic practices had been used"*.

Several online commentators noted that one low-input sustainable agricultural approach that had been ignored in the debate is permaculture, a holistic system of agricultural and architectural design inspired by both traditional knowledge and modern sciences. Permaculture focuses on the relationship among elements and on where and how different ecologically sound methods of production can be applied. One commentator, Robin Bourgeois, asked why suddenly sustainable agricultural production systems would become the main practice? *"When we look at the forces which have shaped the transformation of agriculture and food production, we see that the drivers are exogenous, that they do not come from the offer but from the demand."*

Another controversial issue linked to the use of fossil fuels that was touched on in the debate is genetically modified (GM) seeds, especially those genetically reconfigured to fit into a high-input agricultural system, for instance, to facilitate mechanization. GM seeds often depend on the use of specific petroleum-based pesticides and fertilizers, sold as part of a package by large multinational corporations. Proponents say that GM seeds are necessary to avoid a major world food crisis. For instance, **Kavita Prakash-Mani**, argues that *"certified clean seeds, bred for local conditions and able to withstand changing weather patterns, will result in much higher yields and use less environmental resources."* However, critics argue that GM seeds reduce biodiversity, increase the occurrence of plant diseases and pests and affects soil quality while eroding traditional ecological knowledge, compromising food sovereignty and affecting human health.

Rokeya Kabir, argued that *“the goal should be to free our farmers from dependence on the seeds of multinational companies and its local agents, including giant corporate-NGOs.”*

Planting indigenous crop varieties safeguards farmers’ food sovereignty, reduces production costs, lessens the use of chemical fertilizer and pesticides and augments the use of organic and environmentally friendly alternatives, thus producing healthier and safer food. She further stated that less dependence on external inputs and modified seeds promotes diversity among species and varieties, ecosystems and habitats, knowledge and practice, and even relationships.

Similarly, **Mooney** called for the promotion and support of free use and exchange of non-engineered seeds around the world, a practice that thrived until the 1920s. To preserve farmers’ food sovereignty and to ensure global food security **Mooney** urged: *“gene banks, as a policy priority, must multiply the peasant varieties and make them freely available to peasant organizations upon request.”* One commentator responded that he could not easily *“imagine that farmers would be interested in a legume for nutrition and soil fertility; high yielding dual purpose cowpea from certified seeds whose tender leaves serve as a vegetable for human consumption, while the mature leaves form an important ingredient in chicken feed and the seeds provide a rich source of protein”*, because such a multipurpose species would serve each of the purposes only minimally.

Several contributors pointed to food waste as an illustration of the inefficient nature of our current fossil-fuel based agricultural system. **Mooney** explained that at least one-third of the food produced is wasted during production, storage, transportation, processing, on our plates and in the fridge. More is lost when we consider that fishmeal and grain is fed to livestock or automobiles and that in the global North (and increasingly in the global South) at least one-quarter of the ingested calories are unnecessarily consumed, contributing to obesity. The unavoidable conclusion, **Mooney** continued, is that *“the industrial food chain is hugely ineffective. It only partly feeds people in the industrialized countries and has little left over for the rest of the world”*. In terms of potential solutions some commentators suggested improving household food storage capacity, as well as community-based food banking systems; others suggested urban food wastes to produce very low cost organic fertilizer. Several essayists and commentators contended that a radical change in our food system is needed; the ethics and principles of biodiversity-based ecological agriculture were noted an essential first step. According to a commentator from New Zealand *“there is no longer any question that biodiversity-based ecological agriculture can feed the world and especially those who are currently starving or malnourished.”*

Finding an alternative to fossil fuel-based agriculture also requires challenging the assumption that bigger is always better. Most participants challenged the notion that we need large-scale industrial agriculture to feed the ever-growing human population. According to **Mooney**, at least 70 percent of the food the world actually consumes every year is provisioned by small-scale farmers. **Michael O’Gorman, Founder of the Farmer Veteran Coalition in the US**, argues that increasing the number of small farms is crucial if we aim to create healthier foods and healthier farms. Similarly, Gordon Wagner of Food Security Strategies commented that *“the answer to food security is in the restoration of the small farm in the Global North and every effort to prevent its demise in the Global South.”* However, it was also noted that small-scale farming will not be a panacea, especially if smallholders have no alternative to the global food chain that is currently controlled by profit-driven multinational corporations. *“Small is often far from beautiful.”*

Many essayists and commentators emphasized that consumer support for the production of healthier food (buying locally grown products and supporting organic or BEA farms), will be insufficient to achieve a systemic shift. Governments at all levels should invest in infrastructure that supports the production and distribution of ecologically and socially sound foods so that these healthier products become affordable to the poorest consumers, as is currently done for conventional food. Many also argued that it is government’s responsibility to help consumers make informed decisions about the food they purchase for themselves and their families, via awareness programs and regulation. Some commentators added that costly fair trade or organic certification processes, with rigorous codes of conducts, should be made more affordable to small-scale farmers, and should be monitored and controlled by farmers’ own organizations.

4 WHO IS IN CONTROL?

Many contributors affirmed that food insecurity, hunger and poverty are not technical issues caused by insufficient food production, but rather political issues related to uneven distribution. They argued that the implementation of strategies to reduce inequalities should therefore be the starting point for achieving food security. Commentator Ana Iris Martínez contended that: *“the companies that control 60 to 80% of global food production and distribution have a huge ethical responsibility, not only to make their operations more transparent, but also to actively contribute to reducing these inequalities.”*

There was consensus among participants that a food-secure future will not be possible without addressing issues of gender inequality. For instance, **Kabir** stated that *“rural women are a major part of the farm workforce, yet are virtually invisible to family, state and society”*. In many countries of the global South, women represent an increasing share of agricultural labour, as more men have left to look for jobs in the cities or abroad. **Madiodio Niasse**, Secretariat Director of the International Land Coalition (ILC), concluded that the increasing feminization of farm labour has rarely provided women with greater rights or improved labour and living conditions. **Kabir** noted that to be eligible for government funding for farm supplies in Bangladesh, farmers must prove they own land, which many women cannot, because the land is in their husbands' names.

Susan Godwin, a Nigerian farmer, also described women farmers' lack of access to land and to the product of their own labour: *“We have to hire the land from the men farmers. Men also want women to work on their farms, and take advantage of women when they hire them. The land women get to farm is usually degraded. Men don't think about the fact that women are farming in order to feed and educate their children, because the men in their households have not done that.”* She expressed worry that her daughter wants to become a farmer. A commentator from Peru appreciated this and also sees youth wanting to move back into agriculture, against all odds: *“A young woman of about 27 years told us that many of her family criticized her for her decision to move out of Cuzco, but now that they see how she lives and her achievements, they have congratulated her because in some cases she lives in better conditions than others in her family”*

A number of contributors viewed supporting women's land tenure security as necessary for enhancing the status of women, addressing gender inequality and advancing women's social and economic empowerment. **Niasse** pointed out that *“evidence from around the world shows that when women have more influence over economic decisions (as is the case when they have secure land rights), their families allocate more of their incomes to food, health, education, children's clothing, and children's nutrition.”* He cited a FAO study to the effect that closing the gender gap in agriculture would increase average crop yields about 20–30% on women's lands, equivalent to a 2.5 to 4% increase in domestic food production, and 10–20% decrease in the number of undernourished people worldwide.

Niasse contends that land ownership, while an important means of achieving tenure and food security for smallholders and particularly for women, is rarely sufficient to secure land rights. One commentator argued that property rights and land ownership do not always translate into land tenure security since foreign investment in land often results in the expulsion of the rightful owners. Moreover, even with secure land tenure, women may not be able to make their own decisions regarding land and resource use or farming practices. According to **Niasse**, *“a better understanding of intra-household resource allocation and governance, as well as documentation of good practices, could help serve as the basis for more relevant, better targeted, and more easily implementable policies and laws.”*

The issue of land size was tackled by **Nicko Debenham**, Director of Development & Sustainability at Armajaro Trading Ltd, who argues that the fundamental problem for both female and male smallholders is the size of their farms, which are too small to generate an

acceptable livelihood. Commentators contended that small farm size is often not the primary issue, since many smallholders only use a fraction of their total land holdings because they cannot cover the cost of doing more. A more fundamental issue is farmers', and especially women's, lack of access and control over the means of production.

Some participants argued that land reform is an essential step towards reducing social inequalities within our food system. **John Ambler**, Vice-President for Strategy at Oxfam America, proposed a market-led land reform, based on the purchase of land by farmers through long-term loans repaid at a discounted rate. Commentators raised the fear that such a reform could push farmers into deeper financial distress, unless the land is good quality and governments take responsibility for providing the necessary resources to secure and sustain farmers' livelihood and well-being.

When discussing peasants' unequal access and control over agricultural resources and over the output of their labour, many contributors to the debate mentioned the issue of unequal North–South agricultural trade relations. **Poelma's** vision that a resilient and sustainable agriculture can only be achieved through comparative advantage, open trade, and efficient markets, was criticized by commentators who said that it is a right and obligation of countries in the global South to defend their own agricultural products against cheaper foreign foods, in order to stimulate local agriculture. Garbriel Pons from Spain, while expressing his appreciation for the participation by some of the larger global private sector actors, challenged the concept of comparative advantage and open trade, arguing that poverty and inequality arise from the lack of comparative advantages. Some participants also mentioned that poorer countries face unfair competition from industrialized countries that heavily subsidize their farmers. **Roger Thurow**, journalist and Senior Fellow at the Chicago Council on Global Affairs, argued that *“the rich world countries need to scrap trade inequities and policies that for decades have tilted the global agriculture trade in their direction and perpetuated hunger elsewhere.”*

The concept of food sovereignty was central to this part of the debate. According to **Tarcila Rivera Zea**, Director of the Centre for Peru's Indigenous Cultures (CHIRAPAQ), food sovereignty implies: *“control over production systems to be able to decide what, how, and when to produce, as well as control over the cultural environment in which that happens. It also implies control over what is produced and where and how that is placed in different markets.”* Accordingly, **Ambler** envisioned that vast increases in food production will be largely driven by institutional reform and that the key to institutional reform will be *“placing citizens and primary producers in central oversight and ownership positions.”*

Many participants in the debate emphasized that it is mainly through organization that female and male farmers can overcome the disadvantages they face in the current global agricultural and food system. **Julio A. Berdegué**, Principal Researcher of the Latin American Centre for Rural Development (RIMISP), contended that: *“collective action through community- or resource-based or economic organizations is a particularly powerful tool because it can open ways of using resources that are completely blocked for individual and isolated smallholders.”* Commentator Ekanath Khatiwada added that organized farmers' groups are always in a better position to negotiate better prices for their produce, get better support services from government extension workers and other development programmes, generate local capital base through their saving and credit initiatives, and strengthen farmer-to-farmer support/knowledge transfer. He also noted that good governance mechanisms are essential to sustain a strong and healthy organization. As **Berdegué** stated: *“One ‘public good’ that is often forgotten is political rights. Smallholders need to be able to exercise such rights if they are going to have the voice and power to control the access and use of natural resources that belong to them by law or by custom. If rural communities do not have a say in crafting and enforcing the rules that determine who uses those resources and how they are used, the end result most often will be misuse by those who may not have the right, but have the power.”*

5 INVESTMENT TO SUPPORT INNOVATION

Every wealthy country in the world (Singapore excepted) at some point invested heavily in agriculture. Billions in public funds are still invested annually for research and development, innovation, price support and extension services. Large amounts of public investment and research are focused on maize, wheat, rice and sugarcane, while very little capital flows towards other crops or the investment priorities of small-scale farmers in the global South.

Overall, most contributors agreed that investments should be made in the promotion, development, and preservation of local agricultural knowledge systems. Many argued that indigenous peoples have a fundamental role to play in this process. **Alexis Nicolás Ibáñez Blancas**, Researcher at Universidad Nacional Agraria La Molina, argued that *“indigenous farming could become a motor for conserving biodiversity, promoting ancestral knowledge crucial for climate adaptation, and building alternative development models based on local markets.”*

Participants also suggested that traditional ecological knowledge and new agricultural innovations can be combined and promoted through farmer-to-farmer initiatives. **Dr. Florence Wambugu**, CEO of Africa Harvest Biotech Foundation International (AHBFI) recommended an approach called Farmers-First-and-Last (FFL), which seeks to develop home-grown adaptable solutions to the challenges producers face. FFL highlights the advantages of innovating, adapting to climate change, and creating resilience via small improvements with few resources, built on local knowledge. She contended that *“experts’ ideas about how resource-poor farmers could improve productivity ought to be guided by indigenous knowledge. Low-cost, micro-innovations that make use of local resources have great potential but are often overlooked by mainstream developers of agricultural technology.”*

Kabir wrote that agricultural innovation depends on farmers’ access and control over land resources: *“control over seeds is the lifeline of the farming community and strengthening farmers’ seed system is essential for innovation and knowledge generation.”* **Prakash-Mani** favoured a more technocratic approach to agricultural innovation: *“There is a role for other players and for technology to make the job of farming less hard, more productive, and more sustainable”*. She suggested that organic and technology-driven approaches can come together to create the most effective solutions. **Berdegué** also supported the idea of expanding farmers’ access to a wide range of forms of knowledge and to resource-conserving technologies, *“as long as those technologies also make sense to smallholders from a cultural and economic point of view.”* For **Debenham**, an incorporated farm model would enable better communication and co-operation between farmers and external bodies, such as research and financial institutions, to facilitate knowledge transfer. As such, many participants emphasized the importance of alliances in agricultural knowledge production. **Bisht** summarized by recommending that *“farmers and research institutions must be linked in a web of knowledge creation and application, with joint responsibility for improving production and productivity through joint trials, participatory innovation, and farmer validation of scientists’ claims.”*

Prakash-Mani acknowledged that *“there is disagreement on the impact of technologies and what intervention or techniques are appropriate. Will technology make the farmer profitable or will she get caught in a debt spiral? Will it create a dependency for the farmer or enhance farmer choice? Will it have a detrimental impact on the environment or conserve resources and ecosystems?”* One commentator argued that most technologies are either too expensive or too complicated to implement or replicate locally without difficulties. **Berdegué** contended that well-enforced laws and regulations should constrain certain innovations by placing sensible limits on the use of resources. Similarly, **Ambler** wrote that biological or chemical innovations in

agriculture should be supervised by FDA-like mechanisms at national and global levels, to assess their potential impact on human, animal, and environmental health.

To promote agricultural improvement and innovation, several contributors agreed that farming has to become an attractive profession. For this, farming must be valued and the contribution of small farmers to global food security recognized. **O’Gorman** argued that too few farmers are working to feed too many people. He suggested making agriculture more accessible and attractive for youth by providing practical advice to help new farmers start their agricultural business.

Many participants contended that the future of agriculture depends on our willingness to challenge our entire agricultural system, and especially the unequal power relations upon which it is based. Commentators argued that solutions will only come through holistic and altruistic thinking and actions, and that more efforts should be made to change institutions and attitudes rather than relying on short-sighted financial and technical fixes. According to commentator Till Woehler, *“as long as we don’t address, on a global scale, the causes, that have brought about world problems like hunger, poverty, war, climate change, we will once again be trying just to cure symptoms. The causes are the logic of market forces, the spirit of competition, greed and exclusiveness.”*

In her concluding remark, **Kabir** wrote : *“Our farmers have worked hard to increase food production, but the system is stacked against them. Working harder is not working. We need to change the system. Valuing farmers’ knowledge, experience and innovation is the logical place to start.”* The future of agriculture depends on the ability and willingness of governments, research institutions, socially-responsible corporations, and civil society to join forces towards a common goal, which, **Thurrow** argued, should consist of *“creating the conditions for all farmers to contribute as much as they possibly can, not only in how much they produce but also in the nutritional quality of what they grow and what we all consume – while also preserving the environment.”*

6 CONCLUSION

The online debate with the large variety of essays and rich commentary demonstrated widespread interest in the future of agriculture. It also showed how difficult it is to think out of the box, and to come up with radical or new thinking. Virtually all of the ideas and solutions put forward were seen to be within reach, lacking only the political will for implementation.

A few commentators noted that nutrition was missing from the debate and they suggested an additional question: *What if the food we grew was healthy for us and our planet?*

While the debate was not aimed at creating a consensus, nearly all participants appeared to agree that a one-size-fits-all approach is not possible. Only very few people said that a choice is inevitable between the two opposing models of agriculture: premaculture/organic, and oil/chemical dependent. At the same time many contributors suggested that current policies and politics favour the latter. And there was general agreement that multi-pronged approaches are needed, with much more attention paid to the potential of agro-ecological, bio-diverse systems to address problems related to climate change, resource scarcity and fossil fuel dependency.

The labour-intensive agriculture practiced by the estimated 1.5 to 2 billion people currently living in rural food-producing households was seen by many, not as a cause of hunger and poverty, but rather a vehicle for escaping those scourges – if invested in properly. Agriculture is the only sector that can usefully absorb a large labour force. Several referred to the fact that in many developing countries small-scale producers are the largest source of investment in agriculture, biodiversity, and related knowledge systems. Too often, however, government policies marginalize them, or create incentives geared to supporting commercial investments that compete with, or displace these small-scale producers. There is no denying that enormous capital flows and practices of both private and public institutions are geared towards industrial-scale production. This debate has shown that redressing this imbalance is a critical challenge for all stakeholders.

Perhaps due to the way the four broad questions were framed, the contributors approached them with a refreshing degree of optimism. A few commentators questioned their enthusiasm, and some even argued that a decrease in human population will be the only solution.

“Political will does not come naturally”, one commentator wrote. In a context dominated by the fear of food shortages, the pursuit of socially and environmentally sustainable solutions must be fiercely defended or they will be cast aside in the name of increased production.

This debate showed that multipronged approaches; the melding of science and traditional knowledge; the role of consumers; the mixture of large-scale, small-scale and low-external-input – high-external-input production systems, as well politics and power, are essential when imagining a fair and equitable future for agriculture.

APPENDIX: THE ESSAYS

APPLY WHAT WE ALREADY KNOW WORKS

Kanayo F. Nwanze, President of the International Fund for Agricultural Development (IFAD)

In many unlikely and inhospitable places, smallholders are already feeding themselves and their communities and leading their nation's economic growth. Many of the solutions to farming's challenges exist. They need tailoring to each locale and long-term reliable policy support.

The drought-prone South Gansu province of China suffers from limited water and severe soil erosion. It is not a hospitable environment for food production. Yet, despite these harsh conditions, farmers are producing and selling more food. They are feeding themselves and their families. And their incomes are steadily rising.

In degraded areas of Burkina Faso, smallholders are using simple water harvesting methods such as planting pits and permeable rock dams to restore land. They are growing crops on land that was once unproductive.

They are growing crops on land that was once unproductive.

And in the Peruvian Altiplano where extreme temperature fluctuations have been made worse by climate change, some indigenous communities are better fed than ever and their livestock are thriving.

When we look at where agriculture should be a decade from now, we can find examples in what is already being done in the many communities where IFAD works around the globe.

Agriculture, of course, feeds people. It is also an extremely effective tool for reducing poverty. Numerous studies have shown that GDP growth generated by agriculture is more than twice as effective in reducing poverty as growth in other sectors.

With the world population expected to reach 7.7 billion by 2022, there will be no shortage of demand for food in the coming years. Our challenge is to make sure small and medium-size farms get the support they need to help meet that demand.

Too many small farmers are cut off from the markets, services and financing that would allow them to benefit from rising prices and demand.

There are some 500 million smallholder farms around the world, supporting more than 2 billion people. Today, too many developing country small farmers are poor – cut off from the markets, the services and the financing that would allow them to benefit from rising prices and demand. Many do not grow enough food to feed themselves and their families, never mind their communities.

How do we ensure the developing world's smallholders have the resources they need to manage risk, cope with price volatility and help meet the world's future demand for food? There is no simple solution.

Policies and political will can create an environment in which farmers are less vulnerable.

They need the policies and political will to create an environment in which they are less vulnerable. They need investments in everything from roads to get produce more efficiently to market, to skills training to deal better with risk. They need creative partnerships between the public and private sector. They need greater transparency in markets to mitigate the impact of volatility, and greater access to the agricultural research that would let them adapt more effectively to the impact of climate change.

Experience repeatedly shows that when smallholders are given the means and the incentives to increase production, they can feed themselves and their communities, lead their nation's agricultural and economic growth, and contribute to food security.

Indeed, small farms are often more productive per hectare than large farms, when agro-ecological conditions and access to technology are comparable.

Small farms are often more productive per hectare

If we want smallholders to contribute to the global food supply a decade from now, they will need access to rural and agricultural finance, specifically geared to their needs, so they can invest in their farms, like the farmers participating in an IFAD-funded project in Bangladesh who can take out seasonal loans to cover the costs of crop production. Their repayments are made four to six months later in a single instalment, reflecting the cash flow cycle of farming.

They will need access to risk management tools, like the farmers in an IFAD-WFP pilot project in China who protected their rice crops against the risk of drought with weather index-based insurance.

Ten years from now, we see farmers with access to paved roads, like the farmers of the Pacific Island of Tonga who can now get their goods to market in a fraction of the time it once took.

Ten years from now, farmers will have paved roads that get their goods to market in a fraction of the time it once took.

And we see them with access to modern storage facilities, like the farmers in Tanzania who can store their produce safely and sell it when the harvest season is over and prices are higher.

When we look to the future, we see farmers with access to newer technologies, like those of Senegal and other parts of Africa who have improved rice seeds that are drought tolerant, require less weeding and mature more quickly. These farmers have seen yield increases ranging from 25 to 250 per cent. They are able to grow more, sell more and earn more.

We also see them using improved traditional techniques, such as the Tassa or *zaï* planting pits that farmers in Burkina Faso and Niger dig before the onset of the rains. These pits collect and store water, contribute to soil fertility and may help restock depleted water tables.

In a world where the impact of climate change is already having an effect on many poor farmers, we see smallholders doing their share to reduce greenhouse gas emissions, and benefitting themselves in the process. Like the farmers in China and Eritrea who are generating energy for their homes from the methane produced by human and animal waste.

To raise their incomes, we see farmers working with private-sector partners to get their produce to new markets, as they are doing in Guatemala—and doing so on terms that reduce the risks they face when entering into business transactions with new partners and markets.

Throughout the world, we see farmers' organizations forming and gaining in strength so that farmers have greater bargaining power in the marketplace and can influence national, regional and global agricultural policies.

And ten years from now we see national governments following through on their long-term commitments to agriculture, backed by greater investment from themselves and the international community.

National governments will follow through on their long-term commitments to agriculture.

There is no secret formula that will eliminate poverty and guarantee food security overnight. But we know that small-scale producers—including family farmers, pastoralists and artisanal fishers—hold the key to reducing poverty and hunger.

They can thrive if they have the right policy support and the right training. If they are connected to markets and have access to financial services and agricultural technologies. If they are

farming in ways that respect and respond to the natural environment. And if they have committed support from central and local governments.

In other words, we need to take what we already know works and apply our knowledge, tailoring our efforts to the conditions of a specific region, or even a specific village—responding to the wishes of local people themselves—so that in ten years' time we will have created lasting change, and a world where people are less hungry and have more opportunities than they do today.

Kanayo F. Nwanze is President of the International Fund for Agricultural Development (*IFAD*). Nwanze has over 35 years of experience across three continents, focussing on poverty reduction through agriculture, rural development and research.

RISKY BUSINESS

Sophia Murphy, senior advisor to the Institute for Agriculture and Trade Policy's Trade and Global Governance Program

Agriculture is a risky business, not only because of its dependence on the weather. Governments, the private sector and farmers themselves need to build robust and overlapping risk-management systems that provide farmers with more than one avenue for protection.

Agriculture is a risky business. At the mercy of inclement weather and pests, a frequent casualty of war, and subject to its own particular demand constraints and market failures, agriculture merits a branch of economics all to itself. The risks are not just economic: they also link to biological diversity and natural resource management, to culture and social relationships.

The risks are political, too; most farmers are subject to relatively strong government involvement in their sector – which is not surprising because everyone has a stake in agriculture. Beyond the essential fact that agriculture is fundamental to our survival, agriculture matters because it is a powerful motor for the eradication of poverty¹.

To realize the potential of agriculture to end poverty, however, farm prices need to be stable. Stable does not mean static: prices need to reflect supply and demand, and to a degree shortages are best managed by price. But if left entirely to the market, food prices are inherently too volatile, reflecting the uncertainties of production as well as the effects of demand elsewhere, a demand created by globalized markets that contain enormous disparities in wealth. As agricultural economist C.P. Timmer² says, 'Only political action and public response from governments can provide stable food prices.'

Economic forces are linking farmers from disparate parts of the world as they have never been linked before.

Two particular kinds of risk pose very modern versions of age-old challenges. The first is climate change—humankind has always been at the mercy of the weather, but today we are also directly responsible for making the weather less predictable.

The second is price volatility. In an era of globalized markets, deregulated capital flows and free trade, economic forces are linking farmers from disparate parts of the world as they have never been linked before. Paul Nicholson³, a farmer from the Basque region of Spain and a leader with La Via Campesina (LVC), describes the creation of LVC in the mid-1990s as a response to the similarities of the challenges that globalization presented to farmers in Minnesota and the French Midi, in Bamako and Bandung.

What risk systems to use?

These risks are real, and the public has an interest in helping farmers to mitigate them. Many tools are available and risk management systems are useful in many different contexts. Governments need to build robust and overlapping systems, providing farmers with more than one avenue for protection.

Public procurement and storage of grain has historically provided an important risk reduction tool.

One set of tools rests with farmers, though government and NGOs can play a helpful role. Collective action offers an important way for farmers to strengthen their political and

1 <http://dfid-agriculture-consultation.nri.org/launchpapers/michaellipton.html>

2 <http://www.pnas.org/content/109/31/12315.abstract>

3 <http://www.tandfonline.com/toc/fips20/36/3>

economic bargaining power, and to reduce their business risks. For example, farmers can form buyers' co-operatives to obtain fertilizer or seed or other inputs at reduced prices, or sellers' cooperatives to negotiate better prices for a larger volume and to invest in technologies or storage facilities. Most fair trade certification depends on farmers working cooperatively.

A second set of tools rests in the state's hands. Governments can reduce risks for farmers significantly by providing basic services, such as reliable (and affordable) transportation, affordable healthcare, and safety nets in times of crisis. Governments at all levels can also procure and hold stocks. Public procurement and storage of grain has historically provided an important risk reduction tool.

Brazil has experimented with public procurement from smallholder producers in an effort to provision safety nets for the urban poor while providing an income for the rural poor. While not easy to put into practice, the policy opens the possibility of a virtuous circle in which the risks that farmers face are reduced at the same time as consumers are provided with affordable food.

Holding stocks of food can help mitigate wild swings in prices by alleviating uncertainties about market supply. Credible, transparent and properly managed stocks provide a powerful tool against volatility that can work for farmers and consumers alike.

A third set of tools rest with the private sector. To give just one example, mobile phone networks have become a way to enable people without bank accounts to move money from city to country and back, while also providing farmers with price information they can use in bargaining with traders. As both a communication tool and a financial system, mobile phones have made an enormous, positive difference to many smallholder producers in the developing world.

Mobile phones have made an enormous, positive difference to many smallholder producers in the developing world.

More prosaically, the private sector offers (at least) two big risk management systems for agriculture. One is commodity futures markets, which allow producers to sell agricultural commodities and processors to buy them before they are harvested. The parties sign a contract to deliver a certain amount of grain at a certain price on a given day. The contract itself is then bought and sold by speculators, who provide the money that the farmer needs but the processor does not want to spend until the grain is delivered.

The contract may change hands many times, with buyers and sellers trying to anticipate future prices based on projections of supply and demand. In this way, the commodity market cushions shocks.

There are costs as well, of course. Some of the attempts to create commodity exchanges in Africa (for example in Nigeria and in Ethiopia) have struggled to attract farmers because the transaction costs are great, and the minimum production to generate a contract is too big for the majority of producers.

In established markets, such as the Chicago Board of Trade (CBOT), the deregulation ushered in over the last decade or more has also undermined the effectiveness of the futures markets for price discovery. Financialization of the exchanges has increased short-term volatility, adding a new source of risk for farmers.

The second big private sector contribution to risk management is insurance. Historically, insurance companies have avoided agriculture. The risks are largely systemic (everyone in a large area faces the same growing conditions) as opposed to idiosyncratic (risks that everyone runs, but that few people are likely to suffer simultaneously, such as a house fire). This makes it difficult to manage as a private firm—you either have a great year because you sell lots of policies but get few claims, or you go bankrupt, because half your customers claim at once.

Thus even highly commercialized markets, such as the United States, have very significant government involvement in their insurance programmes. The government subsidizes premiums,

the administrative costs of the private insurers, and the final pay-outs. Indeed, the U.S. example is not an encouraging one, as both the insurers and the farmers end up with too few risks, leading to poor decisions regarding where, what and how much to plant.

New experiments with insurance in the developing world have shown more promise. These are public–private partnerships, meaning that the costs are not entirely borne by the private sector. Oxfam is involved in one scheme in Ethiopia with Swiss Re, the World Food Program and USAID (R4 Rural Resilience Initiative) that has shown success.

In Bolivia, the International Labour Organization (ILO) is working with Gates Foundation money to offer insurance to the smallest-scale producers⁴. Insured risks include crop failure and death of a close family member. This project has shown success as well, and will be rolled out nationally in 2013.

What if?

Farmers need strong risk insurance programs to have the confidence to invest in what they do. Without investment, agriculture stagnates, and so does food production. With investment agriculture can grow the food the world needs, rural economies thrive, and rural–urban migration slows.

Farmers need risk insurance to have the confidence to invest. Without investment, agriculture stagnates, and so does food production

Risk management systems should not encourage a farmer to take unwarranted risk. Farmers should be responsible for making good business decisions about their operations, not encouraged to take unnecessary risks as the shallow loss insurance programs proposed in the 2012 U.S. Farm Bill would. But the systems should be strong enough to protect farmers and their households from destitution, especially where the risks involved are outside farmers' control, as is the case with climate change and international price volatility.

The public has a powerful interest in what comes of this, not only because of the primordial need to secure an adequate food supply, but also to ensure agriculture plays a vibrant role in national development, creating jobs, generating capital and husbanding natural resources for the future.

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⁴ <http://www.guardian.co.uk/global-development/poverty-matters/2011/aug/19/bolivia-crop-insurance-credit-alternative>

A LESS RISKY BUSINESS: HELPING SMALLHOLDERS COPE WITH MARKET AND CLIMATE RISKS

Shenggen Fan, Director General, International Food Policy Research Institute (IFPRI)

We must invest in reducing the two greatest risks smallholders face: weather-related risk from climate change and market-related risk from globalization. Hope lies in stress-tolerant crops and innovative insurance plans, as well as social safety nets and other public welfare programs.

While smallholder farmers in emerging economies like China and Vietnam may have an opportunity to increase their farm size, farms will remain small in many parts of the developing world. Smallholder farmers are central to global food security and poverty reduction, particularly in sub-Saharan Africa and South Asia.

However, like all farmers, they are affected by two global shocks: climate change and increasing volatility of agricultural commodity prices. In addition to reducing crop yields, climate change increases the magnitude and the frequency of extreme weather events, which increase smallholder vulnerability.

Price volatility makes it difficult for farmers to know at the planting stage what crops they can sell profitably at harvest time, or whether the bottom line of a usually profitable but input-intensive crop will turn negative when input prices suddenly rise.

Managing climate change risks

Climate variability forces farmers to adapt their agricultural practices. While for a few farmers in some regions climate change may turn out to be beneficial, many farmers will face major challenges to maintain or even improve their productivity, which is necessary to feed a growing world population. Most importantly, a less predictable climate marked by extreme weather events and changing seasons considerably increases farmers' difficulties in managing related risks.

One solution to reducing weather-related risks is to develop—and for farmers to adopt—crop varieties that are tolerant to cold, heat, flood, or drought. Such varieties reduce the yield variability that farmers face when extreme weather events occur, and increase overall mean yields, and offer concomitant benefits not only for smallholders, but for all producers as well as consumers. For some countries in sub-Saharan Africa, research on drought-tolerant maize, millet and sorghum is expected to generate benefits worth millions of dollars each year.

Research on drought-tolerant maize, millet and sorghum is expected to generate benefits worth millions of dollars each year.

Another solution is for farmers to switch from drought-sensitive to more drought-tolerant crops⁵, in which case farmers' access to the required planting material has to be ensured, whether through formal programs⁶ or an informal seed system.

For stress-tolerant crops developed through modern plant breeding, target countries need to have regulatory frameworks in place that ensure an effective management of the potential benefits and risks of genetically engineered crops. Such frameworks should not discourage the development of valuable technologies through regulatory delays, nor should it act as a barrier to crops developed by the public sector or small private firms by imposing high regulatory costs.

5 See: <http://ebrary.ifpri.org/cdm/singleitem/collection/p15738coll6/id/245/rec/8>

6 <http://harvestchoice.org/publications/potential-impact-investments-drought-tolerant-maize-africa>

Innovative insurance schemes also offer great potential to help smallholders cope with weather-related shocks. Moving away from single insurance policies that compensate for average actual losses and instead promoting simple weather securities with fixed payments triggered when predetermined weather events occur has been shown to be a promising approach.

Such “weather tickets” are easy to understand and can be combined flexibly by smallholders according to the level of their risk aversion. Payments from such schemes should stabilize smallholders’ incomes and help them meet their minimum financial requirements when hit by an (insured) shock, thereby reducing their vulnerability to climatic extremes.

Managing price volatility risks

Over the last several years global food markets have been characterized by rising and more volatile prices⁷. In many cases, this has not only reduced poor people’s spending on essential goods and services, it has also impoverished their diets, as people shift to cheaper, lower-quality, and less micronutrient-dense foods in an effort to cope with price increases and maintain overall calorie intake. Moreover, volatile food prices harm producers by increasing uncertainty and making it difficult to plan for production.

In the past, high and volatile food prices were a result of, inter alia, high oil prices, policies that promote the expansion of biofuel production, thin global markets in major grains, and the lack of timely and reassuring information about the world food system. Hence, to manage the risks from price volatility, action is required at both national and international levels.

To manage the risks from price volatility, action is required at both national and international levels

Last year, the Group of 20 (G20) launched an “Agricultural Market Information System” to address the need for more collaboration and better information sharing among participants in global agricultural commodity markets. If successfully integrated into existing early warning systems, this tool should help to reduce price volatility.

In addition, the World Bank launched a new “Agriculture Price Risk Management⁸” product to protect farmers, food producers, and consumers in developing countries from volatile food prices by improving access to hedging instruments and enabling up to US\$4 billion in price protection.

Social protection systems to reduce vulnerability

Social safety nets⁹ and other social protection schemes are instrumental in reducing the hardship poor households experience when being exposed to shocks such as high food prices. In many countries social safety nets reach only a small proportion of those in need—nearly 80 percent of people in the world’s poorest countries lack effective social protection.

National governments and international players are currently scaling up investments in agriculture, food security initiatives, and social protection systems. The World Bank increased its lending volume for social safety nets from US\$1.2 billion in 2006–08 to US\$9.0 billion in 2009–11, and it promotes resilient safety nets in low income countries.

At the national level, Ethiopia’s Productive Safety Net Programme¹⁰ (PSNP) is widely recognized as holding great potential for helping the poor, in particular farm households that

7<http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:22945434~pagePK:34370~piPK:34424~theSitePK:4607,00.html>

8<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTARD/EXTCOMRISMAN/0,,menuPK:4827787~pagePK:149018~piPK:149093~theSitePK:4827781,00.html>

9[http://Inweb90.worldbank.org/oed/oeddoclib.nsf/DocUNIDViewForJavaSearch/66C2D03CAE69AE53852578C7004CFDF/\\$file/ssn_full_evaluation.pdf](http://Inweb90.worldbank.org/oed/oeddoclib.nsf/DocUNIDViewForJavaSearch/66C2D03CAE69AE53852578C7004CFDF/$file/ssn_full_evaluation.pdf)

10 See: <http://www.ifpri.org/publication/impact-ethiopias-productive-safety-net-programme-and-its-linkages>

benefit from the PSNP and also receive agricultural support. Focusing more on improving education, nutrition or health outcomes among the poor, conditional cash transfer programs like Brazil's *Bolsa Família* or Mexico's *Oportunidades* are also examples of improved social protection efforts over the last years.

Moving from rhetoric to action

Given that smallholders currently constitute the bulk of the poor and half of the world's hungry, it is paramount to help them manage the multifaceted risks they face and reduce their vulnerability to shocks from their natural and socio-economic environment. The future of agriculture requires action to increase overall productivity; improve access to technologies that boost smallholders' resilience to weather shocks; ensure access to weather-related insurance schemes¹¹; introduce output price risk management tools; scale-up social protection systems that safeguard productive assets; develop nutritious staple crop varieties; and enhance human capital.

It is paramount to help smallholders manage the multifaceted risks they face and reduce their vulnerability to shocks from their natural and socio-economic environment.

In response to the food price crises of the last few years, a lot has been done to address many of these issues, but the world is still far away from achieving the first Millennium Development Goal of halving the proportion of hungry and poor people. For greater food justice, continued and vigorous support for smallholder agriculture is a must.

Shenggen Fan has been Director General of the **International Food Policy Research Institute (IFPRI)** since 2009. Furthermore, Dr. Fan is the Chairman of the **World Economic Forum's Global Agenda Council on Food Security**, as well as an Executive Committee member of the **International Association of Agricultural Economists**.

11 See: <http://www.ifpri.org/sites/default/files/publications/ifpridp01092.pdf>

HOW INSTITUTIONAL REFORM SAVED AGRICULTURE—AND US!

John Ambler, Vice President for Strategy, Oxfam America

In the world of 2050, healthy food is abundant and politicians view a sustainable agricultural system as non-negotiable. Looking back, it's clear that institutional reform was the key to success in the realms of innovation, production, and consumption.

It is now 2050. And we all have enough to eat. Globally, we are 9 billion strong. Only twenty percent of us are directly involved in agriculture. Yet I repeat, we all have enough food.

Industrialized countries eliminated the subsidies that once undercut the agricultural exports of poor countries. Land reform spread throughout Latin America, and water reform took off in Asia. Irrigation, which once constituted 70 percent of freshwater use, now consumes less than half. New agronomic practices are taking hold worldwide. The world is eating healthier and more locally. The world's politicians view the sustainability of agriculture as non-negotiable.

The world's politicians now view the sustainability of agriculture as non-negotiable.

Looking back over the last 40 years, clearly technological innovation played a part, but the vast increase in food production has been largely driven by institutional reform. And the key to institutional reform has been placing citizens and primary producers in central oversight and ownership positions.

The institutional structure of innovation

Governments are investing significantly more in public sector agricultural research overseen by multi-stakeholder trustee panels. Public agricultural research institutions work with additional accountability since 15 percent of their budgets come from licensing their innovations to farmers. In poor countries, farmer-to-farmer innovation is partially subsidized by government, as are improved agricultural information services.

Private agricultural research is also encouraged, but publically funded innovations are jealously preserved for the public domain. Local boards, which have a mix of government, farmer, and civil society representation, have a large say in setting the private research agenda. While the benefits from agricultural patents derived from private research accrue to the creators, the state sometimes intervenes for the public good, as it once did for HIV/AIDS medicines. Patents produced from government-funded programs are held in public trust, with the income divided equally between inventors and state agricultural programs.

Biological or chemical innovations in agriculture are now supervised by FDA-like mechanisms at national and global levels.

Biological or chemical innovations in agriculture are now supervised by FDA-like mechanisms at national and global levels, which assess their potential impact on human, animal, and environmental health. Special efforts are then taken to inform government and communities on the economic and social implications of such innovations. Major breakthroughs have occurred for crops that grow well under saline conditions and new drought and heat tolerant varieties especially suited for the tropics. Stronger data now show that GMO food crops are often associated with health risks for humans, and therefore are heavily regulated, and are limited primarily to industrial crops.

Investment in innovative water-saving technology is flourishing, incentivized by better valuation of water. Worldwide, water is now acknowledged as an economic good and has a price. Water use efficiency for agriculture is up 50 percent compared to 2012. The state has stepped up in its oversight role and guarantees base flows for ecosystem sustainability.

The institutional structure of production

Smallholder farmers now get significantly more attention from government, including cooperative storage facilities to manage stocks, flows, and prices, improved transport links and loan guarantees for agricultural cooperatives. Rich countries have stopped subsidizing food production, leaving market forces to determine agricultural prices.

Even the poorest of governments have increased their investment in small-scale agriculture by fourfold, primarily through co-investment rather than through full subsidy. Market systems, even in statist countries, are allowed to signal supply and demand. Most countries have disbanded their inept and corrupt ministries of cooperatives, replacing them with wholly farmer-owned "cooperative companies," which have the same status and legal persona as any corporate entity.

All over Latin America, major land reform has occurred peacefully, with compensation paid to former owners thanks to strengthened regulatory safeguards governing the buying and selling of agricultural land. The beneficiaries, mostly peasants, pay for the land over time at a discounted rate. Land reform has served the triple bottom line: higher productivity, more equitable income distribution, and greater ecological sustainability.

Land reform has served the triple bottom line: higher productivity, more equitable income distribution, and greater ecological sustainability.

Heavily dependent on irrigation, Asia, home to nearly half our population, has accomplished major reform in water management, including revamping its water rights frameworks. Significant water rights have been invested in companies controlled by farmers. Water is a tradable commodity, or economic good, but multi-stakeholder water boards closely supervise transactions and form the first point of adjudication for disputes.

Even large irrigation systems formerly run by government have been "privatized" and are now managed by farmer-owned cooperative companies or by public utilities. Irrigation engineers work for the companies, not the government, thus increasing incentives to raise productivity, reduce water consumption, increase equity, and tackle waterlogging and salinity issues.

Water cooperatives sell the water they save to other users, including growing urban areas. Proceeds from sales are reinvested in irrigation infrastructure and in research. For its part, governments now focus on issues above the individual irrigation system, especially ecological sustainability and inter-system water distribution.

In many countries, some agricultural extension services have also been privatized, which has provided the incentive for agronomists and extension agents to develop and disseminate products that the farmers want and are actually willing to pay for.

The long and rancorous debate about the relative efficiency of large-scale mechanized production versus small-scale peasant production is over. We acknowledge that both are necessary. In countries such as the USA, grain production still occurs on large mechanized farms. However, fruits and vegetables, which respond more to higher labour inputs, are increasingly managed by smaller farms.

The long and rancorous debate about the relative efficiency of large-scale mechanized production versus small-scale peasant production is over.

Many developing countries have benefitted from selective mechanization, such as power tillers and small tractors, but except for these areas with major labor shortages wholesale mechanization has been found to be neither necessary nor advisable. And in some places, such as terraced rice fields, the potential for mechanization remains extremely limited.

The proliferation of advanced agronomic techniques continues. The plant root management techniques that started with the system of rice intensification in Asia have spread to new crops and continents. For many crops, combinations of newer and older agronomic wisdom appear to yield superior results. Restructuring the incentive and ownership frameworks for agricultural research

We use mostly organic solutions for soil enrichment.

and extension has been instrumental in producing new knowledge appropriate for the smallholder.

We use mostly organic solutions for soil enrichment. Even soil-rich countries once mistakenly considered soil as inexhaustible. When the nutrients disappeared, treatment relied too heavily on chemical fertilizers. Now, chemical fertilizer consumption is down by 75 percent because of the reduced cost of spreading organic material (largely through new solar and hydrogen-powered transport vehicles), better recycling of organic urban waste, improved crop rotation, and more widespread use of nitrogen-fixing cover crops.

Fisheries and watersheds/forests are now under new management. In the case of the former, international bodies with advanced surveillance equipment monitor fishing fleets in open water to make sure they comply with stricter international fishing quotas, while artisanal fisherfolk have stronger legal rights to coastal fishing as well as the technology to protect them.

Regarding watersheds, the practice of downstream urban areas paying for upstream environmental protection services is now common in selected areas. Cities also pay agricultural producers to use climate-friendly production techniques. New solar and hydrogen-based energy and better battery storage technologies greatly reduce the use of arable land for biofuels.

Institutional structure of consumption

With rising incomes, we faced the severe challenge of high grain prices due to rising demand for grain-fattened meat animals. We still produce large quantities of grass-fed beef, lamb, and goats, but we have managed to reduce per capita consumption of grain-fed meat through public education, new “grain-meat” taxes, and social programs that emphasize the reduction or elimination of meat in the diet.

Politicians around the world have learned that our institutions must be reformed if agriculture is to succeed at producing food, stabilizing the ecosystem, and generating employment. The reform path has not been easy, because it requires continual negotiation and nuanced policies—selective mechanization, appropriate application of artificial fertilizer, judicious GMO use, equitable land reform, improved valuation of water, fairer structure of knowledge creation, and more citizen control over regulation and enforcement.

We have managed to reduce per capita consumption of grain-fed meat through public education, new “grain-meat” taxes, and social programs

New technologies have been adopted if and when these institutions see fit, rather than the institutions being driven by the technology. We all have made special efforts to ensure that poor farmers and women have benefitted from the new structures of ownership and authority.

Thanks to these changes, the world has arrived at a more meaningful place. Whereas back in 2012 the world relied heavily on the principles of profit, extraction, and comparative advantage, today the driving values of our food system are equity, sustainability, and fair distribution. And it works.

John Ambler is Vice President for Strategy at Oxfam America, where he works on building up the agriculture program, identifying best practice across the Oxfam confederation, fundraising and identifying strategic investments for Oxfam America's rights-based programming approach. Earlier, Ambler was the regional director for Asia at CARE USA, based in Bangkok, and for nearly ten years was with the Ford Foundation in Asia.

WHY EAT OIL WHEN WE COULD EAT SUNLIGHT?

Anna Lappé, founding principal of the Small Planet Institute

Anna Lappé argues we should feel a sense of urgency and a sense of hope in transitioning towards more ecological farming. We know how to farm without costly reliance on fossil fuels and we know the freedom it brings from corporations' monopoly control.

In the summer 2012, a team of U.S. trial lawyers filed a class action suit against the agribusiness giant, ConAgra, on behalf of consumers for false labeling. The suit alleges the company didn't properly disclose that the propellant in ConAgra's popular cooking spray, Pam, contains petroleum, butane, and propane.

Petroleum in Pam? Maybe that shouldn't surprise us. Fossil fuels are ubiquitous in the industrial food chain—from this not-so-tasty cooking aid to petrochemical pesticides and the natural gas and fuel used to power synthetic fertilizer operations and livestock “factory farms.”

Considering we now rely on fossil fuel for so many aspects of contemporary agriculture, is it possible to eliminate their use? Michael Mack, the chief executive of Syngenta, one of the world's biggest agricultural chemical makers, would say no: “If the whole planet were to suddenly switch to organic farming tomorrow, it would be an ecological disaster.”¹² The producers of synthetic fertilizer similarly argue that we need their products to ensure an abundant food supply.

But ask experts without a billion-dollar stake in the game and you get a very different answer. The International Assessment of Agricultural Knowledge, Science, and Technology for Development¹³ is considered the most significant and credible research-based assessment of global agriculture. Commissioned by the World Bank, the United Nations, and other international institutions, the 2008 report was completed after four years of exhaustive research by more than 400 experts.

A shift away from fossil fuels requires rethinking the dominant method of agricultural production in the Global North.

The authors urge a transition to “biological substitutes for agrochemicals” and the reduction of “the dependency of the agricultural sector on fossil fuels.” They affirm the enormous benefits of agroecology, small-scale farming, and the sustainable management of livestock, forests, and fisheries, while stressing that moving away from dependence on fossil fuels is vital for global food security.

Such a shift away from fossil fuels requires rethinking the dominant method of agricultural production in the Global North. For today's industrialized food system—as it's often referred to—is dependent on fossil fuels for every key aspect of production.

All crops need fertile soil to thrive, and industrial growers achieve it through synthetic fertilizer. Though nitrogen makes up a significant portion of the air we breathe, this crucial ingredient in fertilizer requires enormous volumes of natural gas to synthesize it and make it usable for farming—33.5 million British thermal units (MMBtu) of natural gas per ton, to be exact. In China, most nitrogen fertilizer production is powered by dirty coal.

To mine for phosphorus, another key ingredient in synthetic fertilizer, requires even more energy as the material becomes rarer and we have to probe deeper and deeper underground.

¹² <http://green.blogs.nytimes.com/2009/11/25/agribusiness-chief-slams-organics/>

¹³ <http://www.agassessment.org/>

Then there is all the fossil fuel needed to power irrigation systems for monoculture crops and the energy required to heat, cool, and clean intensive livestock factory farms. Finally, industrial agriculture also relies on an arsenal of petrochemicals to attack weeds, fungus, and pests.

Proponents call this kind of system “efficient” and “modern,” but the entire system should really be called “input-intensive.” For industrial growers only achieve this so-called efficiency through the expensive—both to their pocketbook and to the planet—use of fossil fuels.

On the other hand, sustainable farming practices—including certified organic agriculture, agroforestry, and biodynamic methods—tap into ecological systems for soil fertility and for managing pests, weeds, and other potential threats to productivity. Sustainable farming is based in biology; industrial agriculture in chemistry.

Sustainable farming is based in biology; industrial agriculture in chemistry.

Sustainable farmers achieve fertility by composting, integrating livestock, or planting soil-nourishing crops. Sustainable growers use natural push-pull technology or other creative and safe techniques to manage weeds and pests, integrating plants that attract insects away from crops, for instance.

Studies have shown that these methods are remarkable for their ability to protect biodiversity and promote soil conservation, clean water, and other ecological benefits. Plus, yields are often as high—or higher—on these sustainable farms.

One 30-year study by the Rodale Institute¹⁴ in Pennsylvania comparing organic and industrial corn and soybean fields found that the sustainable methods on average delivered just as much yield and in drought years as much as 30 percent more.

In one of the largest studies of its kind¹⁵, researchers at the University of Essex analyzed 286 farming projects in 57 countries, including 12.6 million farmers transitioning towards agricultural sustainability—and found a yield increase of 79 percent across a wide variety of crop types. Select just those projects in East Africa and the increase in yields from introducing sustainable farming approaches was 116 percent.

Despite this evidence, promoters of the industrial model insist their system is the only viable path, like Syngenta’s Mack, who said organic farming is the “productive equivalent of driving an S.U.V.” When he delivered this analogy, Mack seemed willfully ignorant of the irony: industrial agriculture is the gas-guzzler, not organic farming. Rodale Institute studies have found that organic methods can use as much as 45 percent less energy than industrial methods.

And that productivity of industrial agriculture that Mack touts comes from a clever accounting trick: Promoters don’t tally all the fossil fuel energy used in production, nor do they account for all the greenhouse gas pollution caused from burning fossil fuels. These are no small numbers—greenhouse gas emissions tied to livestock production¹⁶ alone add up to more than the emissions from all the cars, trucks, planes, and other fossil-fueled modes of transportation in the world.

As we realize the true costs of burning fossil fuels—not just the higher input costs to the farmer but the costs to the planet of global warming—we all should feel a sense of urgency in transitioning toward more ecological farming, as well as a sense of hope. We know how to farm without such a heavy reliance on fossil fuels and we know the freedom it brings from corporations’ monopoly control over industrial inputs like pesticides, genetically engineered seeds, and fertilizer.

14 <http://www.rodaleinstitute.org/files/FSTbookletFINAL.pdf>

15 <http://pubs.acs.org/doi/full/10.1021/es051670d>

16 <http://www.fao.org/docrep/010/a0701e/a0701e00.HTM>

We also know how sustainable farming empowers women, while models that require purchased inputs to succeed by design disadvantages them, not least because most women farmers don't have access to credit or, if they do, it comes at a very high cost. In the wake of the spread of sustainable farming training in the Indian state of Andhra Pradesh ¹⁷, for example, debt levels among women farmers dropped dramatically while food security went way up.

If there is such urgency, why aren't we seeing a shift to agro-ecology occurring? In large part, the political power of the fossil fuel industry and the lobbying clout of agribusiness have kept us trapped in our dependence on fossil fuels. In the United States, agribusiness spent more than \$173.5 million ¹⁸ lobbying around the 2008 farm bill—the U.S. federal policy that shapes agriculture here and to a large extent around the world. Their lobbying ensured that the true costs of industrial agriculture would continue to accrue to taxpayers, not the polluting corporations.

The true costs of industrial agriculture would continue to accrue to taxpayers, not the polluting corporations.

So, could we ever find ourselves completely freed from fossil fuels in agricultural production? Yes, the evidence shows that there is no scientific case for continuing to be so reliant on fossil fuels: indeed, shifting away from fossil fuel dependency would make our food system more resilient and productive.

And we could do so without risking greater food insecurity. In fact, natural methods of enhancing soil fertility, of weed and insect management, and more—make farming more affordable. When farmers rely on knowledge of ecological systems, not costly inputs, they can save and share seeds, and their soil is healthier and more resilient, making their fields naturally more productive.

Sure, we might not be able to go cold turkey on fossil fuels anytime soon, but we certainly could begin shifting in that direction and see a dramatic improvement in the sustainability and long-term viability of our food system. And I doubt anyone would miss that petroleum in our Pam cooking spray.

Anna Lappé is a bestselling author and sought-after public speaker, respected for her work on sustainability, food politics, globalization, and social change. She is a founding principal of the **Small Planet Institute** and the **Small Planet Fund** and has for more than a decade been a key force in the growing international movement for sustainability and justice in the food chain. Her latest book is *Diet for a Hot Planet: The Climate Crisis at the End of Your Fork and What You Can Do About It* (Bloomsbury).

17 <http://www.scribd.com/doc/21632080/Ecologically-Sound-Economically-Viable-Community-Managed-Sustainable-Agriculture-in-Andhra-Pradesh-India>

18 <http://www.foodandwaterwatch.org/reports/cultivating-influence/>

WE CAN REDUCE FOSSIL FUEL USE, BUT WE NEED CHEMICAL FERTILIZER

Prem Bindraban, Director of ISRIC (World Soil Information)

We mustn't allow emotions to cloud our understanding of fundamental natural laws. To feed a world of 9 billion people without chemical fertilizers would irreparably damage biodiversity. Let's reduce fertilizer overuse in China and shift that to Africa, where lack of fertilizer is a major cause of hunger.

The availability of sufficient food has been a concern throughout human history. Understandably, the fear that food will be lacking evokes strong emotional reactions, especially when forecasts, often based on extrapolation of past trends, portray a bleak future.

Emotions are a powerful driver, but they may lead to solutions based on false hopes if they ignore basic eco-physiological processes or physical, chemical and biological laws. A ban on fertilizer use as in organic agriculture, for example, would not help attain global food security; subsidizing biofuels wouldn't reduce GHG emissions; and pleading for vegetarian diets excluding (red) meat consumption prevents exploitation of ecological opportunities, despite the honourable intentions that give rise to such strategies.

Emotions are a powerful driver, but they may lead to solutions based on false hopes.

Energy for biology

Discussion of energy use in agriculture must begin with these unavoidable processes and laws, first of all the fact that plant growth depends heavily on the availability of "reactive" nitrogen, which is commonly applied as chemical fertilizer manufactured in a process that is very energy intensive.

Can we find a way around that? Inert nitrogen gas in the air can be converted naturally into the "reactive" nitrogen plants need by lightning or through fixation by bacteria living in symbiosis with legumes. On highly fertile soils and with sufficient water, legumes can fix 300 kg of nitrogen per year per hectare, half of which is taken up by the two consecutive crops planted thereafter.

Such "natural" fertilizer provides a maximum yield per hectare of 2–2.5 tons of cereal equivalents, a level is comparable to average yields in Europe and North America in the year 1900. Current global cereal yield is 3.5 tons per hectare, thanks largely to chemical fertilizers. In Europe it is 6.5 tons and in the Netherlands it surpasses 9 tons.

Yield levels for cereals in sub-Saharan Africa are between one and 1.5 tons per hectare and even so, soils are degrading because the nutrients removed with the harvest are not replenished. Africa's yields could indeed be increased by optimizing recycling and other natural processes. But only to about two tons per hectare. Inherently poor soil conditions and erratic rainfall mean productivity is inherently low and cannot be increased without "external interventions."

Natural processes have limits.

Natural processes have limits. If all farmers phased out use of chemical fertilizers and average yields fell to only 2 tons per hectare, the demand for food could only be met by expanding the acreage under cultivation. A vegetarian diet requires 1.5 kg of grain equivalents (GE)¹⁹ per person per day. Thus, if we all became vegetarians, nearly five billion metric tons GE would be needed for the world's nine billion people in 2050. At yields of only two tons per hectare, agriculture would have to expand to 2.5 billion hectares –1 billion hectares more the current 1.5 billion, with dramatic implications for world biodiversity.

¹⁹ Grain equivalents represent the converted demand of a basket of dietary items.

If all were to adopt a European dietary level of 4.5 kg GE, a total of over seven billion hectares would be needed, which exceeds all the available land there is. Hence the “artificial” conversion of nitrogen (N₂) into reactive nitrogen is essential if everyone is to eat.

We can limit over-use of chemical fertilizers. Yields in Europe have increased over the past two decades while fertilizer use declined. A similar process to reduce the excessive use of nitrogen in China without sacrificing yield would free up about 70 kg of fertilizer per hectare. If those 70 kg per hectare were then used in Africa it would double yields. The fact is, not using artificial fertilizers in Africa is a major cause of soil degradation, productivity loss and poverty.

The Haber-Bosch nitrogen fertilizer-creation process will remain essential to secure world food availability while maintaining biodiversity. Making reactive nitrogen requires a lot of energy and the amount we need will increase over time. Therefore, we must seek to maximize the amount we recycle, so as to limit energy expenditure.

Yields in Europe have increased over the past two decades while fertilizer use declined.

Energy in farming

On farms, energy is also used in several “non-biological” practices, to enhance the productivity of labour and optimal use of external inputs and natural resources. These include the use of fossil fuels as a direct energy source for field operations such as ploughing, weeding, input application and harvesting, and as an indirect source for the production of machines and agro-chemicals like herbicides and pesticides.

Energy is also needed in the wider food system, i.e. in transport, storage, processing and retail. Total direct and indirect energy use in agriculture in industrialized nations is about 1 percent of total energy use; and total energy use in the entire food system adds up to 10–15 percent of all energy use. Overall, energy consumption in agriculture peaked in the early 1980’s and has gradually declined in several developed economies.

Efficiency and alternatives

Several practices can be adjusted to reduce energy requirements, yet these will imply trade-offs. Because ploughing consumes so much energy, minimum or zero-tillage may reduce the use of fossil fuels by almost half. However, these tillage practices are associated with increased use of herbicides, the production of which can almost fully undo on-farm gains in energy conservation.

Controlled traffic can reduce energy requirements by as much as 30 percent, for instance because compressed soil need not be ploughed over and over. More precise application of external inputs according to crop conditions can also raise energy efficiency. Modern greenhouses are so efficient they can even be net producers of energy.

In principle all fossil energy can be replaced by other forms of energy. The energy needed in the food chain for stationary processes such as the production of agricultural inputs (including reactive nitrogen) and food processing may be supplied by solar or wind power.

Yet, alternative sources for traction may be difficult to obtain. There are real technological limits to solar-powered ploughing for instance. To convert the 20 litres of diesel needed to plough one hectare (200 kWh), a tractor would need to be fitted with 1800 kg (!) of fully charged Li-ion batteries, using current solar technology. Charging that in a day would require about 500 m² of solar cells in the Netherlands and about 250 m² near the equator.

There are real technological limits to solar-powered ploughing.

An additional technological challenge is minimizing transmission losses when converting battery power to a low-speed, high-torque application such as ploughing. Other energy solutions, such

as conversion of solar or wind energy to an energy-dense liquid fuel like hydrogen, or the use of biogas and biofuels, may be more suitable.

However, biofuels production has detrimental effects on biodiversity and GHG emissions. About 25 percent of the total energy contained in rapeseed is needed for the production of the crop under optimal conditions, and about 10 percent of the energy content of biogas is needed for the production and processing into gas from corn or sugar beets.

The conversion of solar energy through biology is highly inefficient.

The fundamental point is that plants fix only 2.5 percent of the solar energy they capture, which makes the conversion of solar energy through biology highly inefficient. Biofuels put a very large claim on productive land and water resources that will ultimately compete with food production. Because of additional claims on land, loss of biodiversity is inevitable and emissions of GHG may exceed those of fossil fuels.

Productivity

Energy plays a central role in food production and that is not about to change. Over the last thousand years agricultural productivity has increased dramatically, parallel to the increased use of energy. In the Netherlands, for instance, the yields of wheat went from 800 kg per hectare in the year 1400, to 1,800 kg in 1900, and to 9,000 kg in 2000, while associated labour requirements dropped from about 600 hours per hectare in the year 1400 to 240 in 1900 and only 12 in 2000.

Power structures, vested interests, economics and other drivers will continue to apply no matter the source of energy for farming.

In other words, by replacing human energy with energy derived from other sources, we have dramatically increased food output from a finite amount of land. At subsistence levels today, small-scale machinery can increase the efficiency of manual labour and animal traction to about 0.5 horse power per hectare, which is considered essential to raise crop yield levels to above 2 tons per hectare.

Whether reducing use of fossil fuels in agriculture will reduce poverty and inequality remains to be seen. Differences in labour quality and income might be larger in zero-tillage production systems than in other systems for instance. In the end, power structures, vested interests, economics and other drivers will continue to apply no matter the source of energy for farming.

Prem Bindraban is Director of ISRIC – World Soil Information – which provides long-term stewardship of quality-assessed soil-related data and state-of-the-art data services to the international science community and stakeholders. He is active in global debates in support of sustainable land use and management through collaboration with strategic partners worldwide, and is leader of international research in agro-production systems at Plant Research International at Wageningen University (Netherlands). He specializes in production ecology and world food security.

THE ULTIMATE, ELEGANT ENGINEERING SOLUTION

Bill McKibben, Founder of 350.org

Low-input agriculture is hardly primitive. It is a highly skilled craft, utterly unlike the formulaic industry that “conventional” farming has become. Instead of continuing to pour oil on plants and hope for the best, let’s embrace an agriculture that requires more attention, more vigilance, and more knowledge.

In summer 2012, amidst an intense drought across the American grainbelt, the world’s most fertile quarter, the CEO of Exxon, Rex Tillerson²⁰, finally admitted that global warming was real. But not to worry, he continued: “It’s an engineering problem with engineering solutions.” Pressed as to what those solutions might include, he gave one example: moving the planet’s ‘crop production areas.’

By crop production areas, I believe he means what the rest of us call farms. And of course it’s not an “engineering solution” to suggest moving them—it’s a hallucinatory solution. You can’t take Iowa and move it north to the rapidly melting tundra, not unless you’ve got a plan for moving the hundred feet of topsoil that makes it Iowa.

You can’t take Iowa and move it north to the rapidly melting tundra.

A more interesting question, then, might be whether we could figure out an actual engineering solution, but one that moves away from fossil fuel in our farming. It’s hard for us to even consider it mentally--we’ve trained ourselves to think that “producing enough food for a growing world” means “big tractors.” At least in places like the United States, we’re used to the idea that soil is mostly a substance for holding plants upright while you pour oil on to make them grow.

It would sure be helpful if we could break the habit, since agriculture contributes more than any other industry to the flow of greenhouse gases into the atmosphere. Since agronomists have by now made it painfully clear that further increases in global temperature will devastate yields, farmers would be doing themselves a great favour if they could start reducing their use of petroleum.

But can we? In the fall of 2008, for instance, the UK’s former chief scientist, Sir David King²¹, blamed “anti-scientific attitudes” among western NGOs for “holding back” a new “green revolution” across Africa. Organic farming across the continent would, he insisted, have “devastating consequences.” Low-input farming seems so old-fashioned (and it does nothing for the share prices of western agri-business firms), yet the data keeps mounting up.

As I pointed out in my last book, *Eaarth*²², a month after King’s statement, the United Nations Environment Programme issued a report²³ showing that yields across Africa “doubled or more than doubled where organic or near-organic practices had been used.” In East Africa, harvests jumped 128 percent. Not only were harvests better, but the organic soils were retaining water and resisting drought. “Saving money on fertilizers and pesticides help farmers afford better seeds,” too. And of course there are cases where you can replace fossil-fuel traction with animals, who have the virtues of being cheap, and providing on-the-job fertilizer.

You can replace fossil-fuel traction with animals, who have the virtues of being cheap, and providing on-the-job fertilizer.

Some of the organic practices introduced were simply traditional farming, while others drew on Western innovations—double-dug beds, for instance. Henry Murage, a small farmer on the western slopes of Mt. Kenya, spent five months in England, studying with experts at an

20 <http://www.reuters.com/article/2012/06/27/us-exxon-climate-idUSBRE85Q1C820120627>

21 <http://britishecologicalsociety.org/blog/blog/2008/09/08/sir-david-king-opens-ba-science-festival-in-liverpool/>

22 <http://www.billmckibben.com/eaarth/eaarthbook.html>

23 <http://www.grida.no/publications/rr/food-crisis/>

experimental farm in the Midlands. When he returned to Africa, he convinced 300 of his neighbors to adopt at least a few of his practices—during the last devastating drought to hit the area, they were the ones who fared best. It's harder work at first—anyone who has double-dug their own beds can remember the knot between the shoulders. But once the work is finished, he says "little has to be done for the next two or three years."

Jules Pretty reports that in one review of Kenyan organic farming in 26 communities, three-quarters of participating households were now free from hunger during the year, and the proportion having to buy vegetables had fallen from 85 to 11 percent." He describes a woman, Joyce Odari, whose 12 raised beds are so productive that she employs four young men from the village to tend them. "The money now comes looking for me," she says.

One problem with what we now call conventional farming (in fact, it's the convention only of the last half-century, and a radical break with the 10 millennia that preceded it) is that you're constantly degrading soils as you turn them into a matrix for holding petroleum-based fertilizer. By contrast, low-input systems get better over time, partly because the soil improves but also because farmers stop relying on the rote advice of chemical companies and start paying attention to their fields.

In Malawi, for instance, tiny fish ponds that recycle waste from the rest of the farm yielded on average about 800 kilograms of fish when they were begun in the 1990s; half a decade later that figure was 1,500 kilograms. Instead of playing themselves out, the way our industrial soils have, these farms were revving up.

And farmers of course talk among themselves—new ideas spread quickly. In Madagascar, rice farmers worked with European experts to figure out ways to increase yields. They transplanted seedlings weeks earlier, spaced them further apart, and kept their paddies unflooded during most of the growing season. That meant they had to weed more—but it also increased yields four-fold to six-fold. Jules Pretty writes, "The proof that it works come from the number of farmers using it—an estimated 20,000 farmers" have adopted the full system, and another 100,000 are experimenting with it. Now word has spread to China, Indonesia, the Philippines, Cambodia, Nepal, the Ivory Coast, Sri Lanka, Bangladesh.

Farmers of course talk among themselves—new ideas spread quickly.

Some of these advances come from farmers spreading the word—others because the conventional systems become too expensive or unreliable for farmers to use. Left to their own devices, more farmers would aim, I think, for a low-input future. But we're rarely left to our own devices—the political power of the agribusiness industry insures that the farmer's field is always tilted in the direction of more oil. That's why, sadly, it's not enough for farmers to simply do the right thing on their own acreage; as always, part of the job is coming together as movements to demand the changes in government policy that will make it easier to farm responsibly.

One important part of that transition is reminding others—and ourselves—that farming beyond fossil fuels is by no means backward or primitive. In fact, it's fossil fuel that turned farming into a formulaic industry and not a skilled craft. Going without oil requires more attention, more vigilance, more knowledge. In a sense—though definitely not the sense the Exxon CEO had in mind—it's the ultimate, elegant, "engineering solution."

Farming beyond fossil fuels is by no means backward or primitive.

Bill McKibben is the author of a dozen books about the environment, beginning with *The End of Nature* in 1989, which is regarded as the first book for a general audience on climate change. He is a founder of the grassroots climate campaign 350.org.

ENERGY EFFICIENCY AND DIVERSIFICATION CAN INCREASE ACCESS TO ENERGY AND FOOD SECURITY

José Graziano da Silva, Director General of the Food and Agriculture Organization of the United Nations (FAO)

Agriculture that uses less fossil fuel must be pursued actively. Renewable fuels, reduced waste and losses, and energy from farm by-products are all solutions that would allow for increased food supplies, while addressing climate change.

Agricultural and energy markets are closely intertwined in a relationship that has grown stronger over time as agricultural productivity has increased through mechanization, fertilization and increased trade. Globally, the agrifood chain utilizes 30 percent of world's available energy with 70 percent of that use coming after the farm gate.

Globally, the agrifood chain utilizes 30 percent of the world's available energy.

On the farm, fossil fuels contribute significantly to inputs both directly to power tractors and farm equipment and to dry grain, as well as indirectly in the form of non-organic fertilizers and electrical energy used to power irrigation systems and other equipment. After the farm gate, fossil fuels are used intensively for transport of agricultural commodities and food processing. Transportation of commodities is increasing with the growth of urbanization and international trade.

The abundance, diversity and resilience of the world's food supply today depend critically on energy inputs all along the production chain, right to the consumer's plate. As a result, it would be virtually impossible for the agricultural sector to *completely* eliminate fossil fuel use without drastic reductions in food availability and affordability, and/or drastic increases in areas cultivated, with its associated increases in greenhouse gas emissions.

However, rising energy costs and concerns about environmental impacts mean that increased energy efficiency of agricultural production could provide benefits to producers and consumers of both food and energy alike. Growth of agriculture's capacity to provide energy services, particularly the use of crop residues and other co-products from food production could similarly benefit both groups. The benefits of using food crops directly in biofuel production are less clear and pose a potential threat to the most vulnerable food consumers.

Most of the 60 percent increase in food production needed to feed the world in 2050 will have to come from agricultural intensification²⁴. Increased energy needs for food production and agriculture's significant dependence on fossil fuels are cause for concern with regard to sustainability, food security and climate change. Energy prices have been linked to increasing food prices²⁵ and thus increases in oil prices are a direct concern for food security and price volatility.

Total energy demand is expected to grow by 33 percent²⁶ over the 2008–2035 period with developing countries representing a significant proportion of that increase. Under current policies, fossil fuels are expected to provide 81 percent of the growth in energy demand in the coming decades. However, available oil supplies are expected to entail higher extraction costs, higher market volatility and greater environmental impacts. Higher oil prices lead directly and indirectly to higher costs of production for farmers, which is eventually passed on to consumers.

Increases in oil prices are a direct concern for food security and price volatility.

24 <http://www.fao.org/docrep/016/ap106e/ap106e.pdf>

25 <http://www.fao.org/docrep/014/i2454e/i2454e00.pdf>

26 <http://www.iea.org/publications/freepublications/publication/weo2010.pdf>

Primary food production and the food supply chain, including landfill gas produced from food waste, contribute approximately 22 percent²⁷ of the total annual greenhouse gas emissions. An additional 15 percent of greenhouse gas emissions results from land use changes²⁸, particularly changes linked to deforestation brought about by the expansion of agricultural land.

Energy is essential for food security and development, but current food production and energy use patterns are unsustainable if climate change targets are to be met. In moving towards a reduced and more rational use of fossil fuels in the agricultural production chain, several opportunities present themselves to enhance producer income and thus food security, while reducing greenhouse gas emissions and improving rural livelihoods.

Current food production and energy use patterns are unsustainable if climate change targets are to be met.

Energy efficiency

While energy use per unit of output in the agriculture sector has consistently fallen over the last several decades, further gains in efficiency can benefit producers by lowering costs, and consumers who will see some of the benefit via lower prices. Fossil fuel use can be directly reduced by changes in tillage practices which not only cut energy use, but may reduce greenhouse gas emissions by capturing carbon in the soil and may reduce crop losses from drought events.

Reductions in harvest, transport and processing losses along the entire supply chain as well as a rationalization of food use through reductions in consumer food waste, could be seen as direct energy efficiency gains, which increase available food supplies and reduce the land area needed to meet demand.

Energy diversification through renewable energy

The diversification of energy use by the agricultural sector, through the production of renewable energy from the agricultural sector can also have wide-ranging benefits. Efficient “on-farm”, and more generally agricultural-sector production of renewable energy, can reduce costs and lower risks of price shocks coming from the energy sector.

The production of liquid biofuels, for example, has the potential to improve income for producers and net-sellers of agricultural commodities. However, these tend to be larger and richer producers, while the price risks are often borne by the most vulnerable consumers. Production to date has been heavily dependent on policy intervention, and care must be taken to coordinate energy and food security objectives.

While caution should be exercised in using food products for the production of energy, the use of some agricultural outputs—such as crop residues, forestry residues, biogas, woody biomass and dedicated energy crops in a multi-cropping system—broaden the options for producers to stabilize farm income. The production of renewable energy may also help mitigate the negative effects of volatility in fossil fuel markets.

Care must be taken to coordinate energy and food security objectives.

Energy access and food security through integrated food-energy production

As mentioned above, the use of co-products in agriculture/food production, such as crop residues like wheat straw, rice husks and corn stover, can actually enhance food security and farm income by improving returns to food crop production, adding an additional revenue stream,

27 <http://www.fao.org/docrep/014/i2454e/i2454e00.pdf>

28 <http://www.ipcc-wg3.de/assessment-reports/fourth-assessment-report/.files-ar4/Chapter09.pdf/view>

and boosting food crop output, while also potentially reducing fossil fuel use in the energy marketplace.

Identifying potential technologies for energy production that are also economically feasible is crucial to ensure the system's sustainability. Innovations that increase the efficiency of on-farm energy production can reduce cash outlays, decrease labour needs and improve access to energy within farm households and in the rural community at large, closing the gap between energy demand and energy access in developing countries.

Reducing dependence on fossil fuels in the chain of agricultural production can have wide-ranging benefits for the sector and contribute to climate change mitigation. While zero use of fossil fuels in agricultural production and value chains is not feasible on a global scale, more efficient use of energy, reductions in fossil fuel consumption and partial displacement by renewable energy from the agricultural sector, by means of processes which do not threaten but enhance food security, should be actively pursued wherever possible.

José Graziano da Silva is Director General of the Food and Agriculture Organization of the United Nations (FAO). Graziano da Silva led the team that designed and implemented Brazil's "Zero Hunger" (*Fome Zero*) programme that helped lift 28 million people out of extreme poverty. In his 30 years working on rural development, food security, and agrarian economics, he has written and edited 26 books.

SUSTAINABLE FOOD PRODUCTION PROMOTES HEALTHY FOOD AND HEALTHY LIVING

Sarojeni V. Rengam, Executive Director of Pesticide Network Asia and the Pacific

The challenges faced by biodiversity-based ecological agriculture are not primarily technical but political. Evidence from three countries shows that farming without fossil fuels works. But such methods will only be adopted widely once we prevail over the political power of agribusiness.

Food production systems that do not use or make minimal use of fossil fuels exist and are successfully feeding communities. Across the world, smallholder farmers, gardeners and other small-scale food producers have decided to minimize the use of unsustainable and harmful inputs that depend on fossil fuels, such as pesticides and fertilizers, as well as heavy machinery –and have in the process reduced their carbon footprint.

Biodiversity-based ecological agriculture (BEA) conserves biodiversity and reinforces ecological principles that are suitable for local ecosystems. The starting point is maintaining soil fertility and, as Professor Norman Uphoff²⁹ of Cornell University says, “Feed the soil and soil will feed the plant.” Soil fertility can be maintained by using alternative sources of soil nitrogen, reducing soil erosion, practicing soil and water conservation, using animal and green manures, mulching and composting.

Such ecological practices include crop rotations that mitigate weeds, disease, insect and other pest problems, as well as farmer field school integrated pest management through understanding crop ecology and pest life cycles. Farmers can make informed decisions in the fields on the use of resistant varieties, the timing of planting, biological pest controls and increased mechanical and biological weed control.

The starting point of biodiversity-based agriculture is maintaining soil fertility.

Many of these practices make use of local ecological resources in a balanced way and then regenerate them. They build on local and indigenous knowledge developed by women and men small-scale food producers over generations, through experimentation and innovation when faced with problems.

These BEA models are in widespread use. For example, 20,000 rice farmers practice low external-input sustainable agriculture in Tamil Nadu; 56,000 rice farmers practice non-chemical System of Rice Intensification (SRI) in Cambodia and around 35,000 BEA rice farmers use the MASIPAG³⁰ approach in the Philippines.

The SRI farmer I met in Cambodia grows rice, herbs and vegetables, keeps hens and ducks, and maintains a one-hectare rice plot with his family members. With the SRI method, the rice has more tillers per plant, larger panicles and heavier grains, and uses less water. Due to stronger root systems, the SRI plant is more resistant to climatic “extreme events,” such as storms or heat spells. Savings from not using commercial pesticides and fertilizers mean the farmer earns more net income. His daughter and son who had left to earn a living in the city have returned to work with him on the farm. The family’s total earnings now are substantially higher than when they were working in the city as labourers.

In the Philippines, MASIPAG was first organized 27 years ago as a collaborative initiative between farmers and scientists to conserve traditional rice varieties and breed new ones. Today, the program maintains an in-situ reserve of a thousand local varieties and another

29 <http://www.panap.net/en/r/post/rice/199>

30 <http://www.panap.net/en/r/post/rice/204>

thousand MASIPAG-bred rice selections, some 300 of which were bred by farmers. These include varieties that are higher yielding, more nutritious, and better able to resist pest attacks.

The approach prioritizes farmers' empowerment and organizing so that rice research and development is needs-driven and builds a sense of ownership among farmers. The MASIPAG farmers continuously experiment with participatory methods as well as ecological farm management and local market development. The program has also expanded into corn breeding, livestock breeding and production, diversified integrated farm systems and local organic market development.

In Tamil Nadu, I met Ganapathy some time ago, a farmer who practices integrated farming with low external input sustainable agriculture. He grows rice, fruits and vegetables, keeps cows, hens and ducks, and rears fish in the rice field. His ducks and fish keep the rice pests in check and fertilize his fields with their waste. The ducks are let into the paddy field to eat the weeds, which has reduced the need for manual labour. The ducks also feed on insects and their egg masses. His small one-hectare farm is fully sustainable and he receives good income from it. His only major external input was a pump that draws underground water. With a small investment in a solar water pump or photovoltaic water pump system, even this conventional pump could become a thing of the past.

Ducks and fish keep pests in check and fertilize fields with their waste.

SIBAT³¹, a civil society organization in the Philippines has lit up the lives of villages by perfecting a micro-hydro system that generates electricity without the use of fossil fuels. This community-managed system provides lights and energy for food and crop processing, and household livelihood needs.

As these diverse BEA examples show, it is possible to produce food and fiber without any fossil fuel: from farmers' seed production and sharing, to ecological food production without the use of pesticides and fertilizers, to alternative non-fossil fuel energy for electricity and processing.

The biggest challenge that remains is the transportation of food products to cities, since most of our transportation still depends on fossil fuel. To reduce this dependency, communities around the world are opting for local food production and local markets.

Local foods and local markets

Growing food locally and consuming locally grown food makes sense since transport costs are minimized, and we can benefit from nutrients that are often lost when foods are processed and transported to urban supermarkets. One system that works is community supported agriculture (for example, the Teikei system in Japan) where consumers invest in organic or BEA farmers by subscription. The organic farmers are guaranteed a fair price and consumers are assured that the produce they receive is clean and free of fossil fuel additives. .

The main challenges to mainstreaming BEA food systems are not technical but political.

As consumers become more concerned about their health and are armed with information, they are opting for more BEA foods. However, access to safe food for urban consumers remains a challenge even with emerging urban gardening projects around the world. This is where we will still need political will and government financial support to fast-track the development of BEA food production and cleaner, renewable energy technologies.

The main challenge to mainstream BEA food systems is not technical but political. We need to prevail over the political and economic power of the agribusiness sector that drives the expansion of the unsustainable corporate model of farming. Government subsidies that fuel these unsustainable production systems – both direct and hidden – have to stop.

31 <http://www.sibat.org/>

Instead, we need to put in place policies and programs that stimulate the widespread adoption of BEA to meet the future challenges of food production and distribution. These policies should promote the conservation of biodiversity, including agro-biodiversity, and encourage local seed banks. Decentralized participatory research that builds on farmers' and indigenous knowledge systems should be funded and institutionalized, and the MASIPAG approach of farmer-scientist partnerships should be emulated.

The sharing of information, knowledge and innovation has to be an ongoing process since BEA is knowledge intensive. Sharing through farmer-to-farmer learning exchanges and easily accessible information platforms are good initiatives.

Since BEA is knowledge intensive, farmer-to-farmer sharing must be ongoing.

Mainstreaming BEA will also require support for the full participation of organizations and movements of small food producers. Their rights, particularly those of women producers, to land and productive resources must be guaranteed so that they can make long-term investments in soil fertility, can develop innovations in agro-ecological practices and can access local markets or develop systems of community supported agriculture. In addition, governments should reorient public agriculture spending toward strengthening and expanding agro-ecological practices through extension services and research.

I believe we can break the food system's dependence on fossil fuels, but the way forward will require a major paradigm shift that needs strong political and societal commitment, starting now.

Sarojeni V. Rengam is the Executive Director of Pesticide Action Network Asia and the Pacific (PAN AP). PAN AP is committed to empowering rural women, peasants, agricultural workers, and indigenous groups in the Asia-Pacific region and globally. The Network seeks to reduce the hazards of pesticides, promote biodiversity-based ecological agriculture and favour the rights of small-scale food producers.

GROUP MUTUALITY PAVES THE WAY TO A SUSTAINABLE FUTURE FOR SMALLHOLDERS

Nicko Debenham, Director, Development & Sustainability at Armajaro Trading Ltd

The fundamental problem for both female and male smallholders is the size of their farms. They are simply too small to generate an acceptable livelihood. An incorporated farm model could overcome many of the current obstacles and be the farming system of the future.

The fundamental problem of both female and male smallholder farmers is the size of their farms and their geographical isolation. They are simply too small to generate an acceptable livelihood.

The reason why farms are so small is due to an inheritance culture which sees the land left to all the children of the deceased. As generations pass, plot sizes become smaller and smaller, and farmers' incomes shrink. In many cases, families have reached the point where farms are a burden, rather than a legacy.

Families have reached the point where farms are a burden, rather than a legacy.

One consequence of the abundance of small and geographically dispersed farms is a low level of knowledge transfer between farmers and other actors in the supply chain, such as research institutions, extension services and financial service providers. The difficulty and expense of trying to communicate with such a wide-reaching group of individuals means that knowledge of better farming practices is not shared. If farmers had access to industry knowledge there would be more agricultural innovation and a better use of technology.

A further concern is that smallholder farmers struggle to make well-informed budgeting decisions. They are often financially illiterate, and their level of income is quite volatile. Therefore, even those few farmers who have access to financial tools are rarely able to obtain loans, because repayment is so uncertain. When loans are available, they tend to be at a high cost because of the perceived risk and expense of administering many small loans when dealing with multiple smallholder farmers.

If farmers were able to raise finance, they would be in a better position to invest in technology and innovations, such as improved planting material and vital inputs.

The situation just described is more severe for women farmers, because of a traditional mindset that views males as the bread-winners. Access to training, membership in farmer organizations and agricultural leadership roles are frequently denied to women. If men and women had equal opportunities in the agricultural sector, not only could families in farming communities benefit from the superior credit-worthiness which women tend to have, but women living in rural areas could be empowered by greater choice and earning potential.

Only when farming is viable will it be a credible career choice for youth.

Help farmers understand the opportunities

Smallholder farmers should be inspired to manage their farms as profitable businesses using a sustainable business model that will attract new generations of farmers into the industry. Only when farming is viable will it be a credible career choice for youth.

It is a dismal reality that a legacy of land passed down through so many generations may no longer be capable of supporting an individual or a family, regardless of the size of investment in inputs. If farmers were to realize the potential production capacity of their farms, they could make better informed budgeting and lifestyle decisions. Farmers must assess whether their farming pursuits are viable.

A recent and ongoing exercise by the independent group GeoTraceability found evidence that an average cocoa farm size in West Africa is less than 1.6 hectares,³² significantly lower than the

³² This figure is based on evidence from the farm mapping initiative, GeoTraceability's, ongoing exercise to collect geographic, agronomic, environmental and socio-economic data on 50,000 hectares of small holder cocoa farms and farmers in West Africa.

previous industry-wide assumption of 2.5 hectares. This implies that many farmers have unrealistic expectations of their potential output and may be investing in false hopes. They may be remaining in a profession which will never be able to provide an income above subsistence level.

With an accurate representation of a plot's production capacity to evaluate their current and potential income, farmers will be more inclined to adopt an entrepreneurial approach in order to raise production.

Farmers may be investing in false hopes.

Additionally, earning capacities can then be more accurately compared to alternative employment opportunities. The point is *not* that an individual must seek off-farm employment, but for farmers to have a realistic appreciation of what can make their farms profitable.

Encourage farmers to work together

Imagine a group of farmers pooling their farms together in mutual ownership. Such a larger-scale, 'incorporated' farm could reduce costs and improve access to market knowledge, industry technology and innovations, and financial tools. Under this business model, each smallholder could choose whether to be a shareholder only, or both a wage-earner and a shareholder.

A group structure would enable better communication and cooperation between farmers and external bodies such as research and financial institutions, to facilitate knowledge transfer. An incorporated farm model would also allow individuals to specialize their roles so that farming efficiency improves and credibility can be built up over time.

Imagine a group of farmers pooling their farms together in mutual ownership.

Many development organizations take the approach of encouraging farmers to work together and support each other mutually.³³ Farmers often form groups which choose their own leaders and then are offered training in sustainable agricultural practices, access to necessary inputs, proven planting material, financial support, community infrastructure and information technology.

Because the farmer group takes mutual responsibility for each member, financial institutions have fewer logistical challenges and can have greater confidence. Leaders usually coordinate the distribution of inputs and planting material relevant to the size and profile of the farms in the group. Over time, the mutuality of the group enables easier knowledge transfer from research centres to farmers groups, which in turn encourages individual farmers to invest and innovate.

Conclusion

Farming must become an aspirational occupation where entrepreneurial farmers belonging to a group and mutually responsible for each other can generate a more-than-acceptable living through sustainable farming. For this to be achieved, the structure of today's agricultural landscape must be adapted to escape the limitations imposed by undersized farms. A new movement consisting of an incorporated farm model may be the key to overcoming this crucial obstacle.

Nicko Debenham is responsible for traceability and sustainability at **Armajaro Trading**, a global soft commodity trading house and supply chain manager founded in 1998. He is also Chairman of **Source Trust** a not-for-profit organization established by Armajaro in 2009 to help farmers improve their livelihoods through sustainable farming practices. He has 25 years experience in the West African cocoa business and was recently appointed chairman of the World Cocoa Foundation.

³³ An example of the approach to encouraging farmer grouping is that of the not-for-profit organization, Source Trust. Established in 2009, Source Trust works with individual farmers to form them into community-based groups around farmer development centres. Each centre provides the necessary tools to improve their livelihoods through improved yields and quality through sustainable farming practices and equal control over resources.

MY DAUGHTER WANTS TO BE A FARMER

Susan Godwin, Nigerian farmer

Many and varied are the challenges we Nigerian women farmers face, from lack of land to uncertain markets to the daily burden of maintaining the household. Working as day labourers brings its own uncertainties. No wonder a future in agriculture is unattractive to Nigerian youth.

When I think of the future of agriculture, I have to say that the youth here in Nigeria do not want to be farmers. They see it is very difficult. They see how hard we work and how little we have, nothing. I have five children. One of them works in the city and the rest live with me. I have a daughter who is 18. She did not go to school and she wants to stay and be a farmer. Now, everything we do is done manually. Maybe modernization would make it more attractive to them.

The lack of markets is also a problem. In 2011, we heard that there was a good market for yams in Lagos, so we hired a lorry to carry the yams there. However, once they arrived, they were not off-loaded for three months. By that time, they had spoiled and the money we earned from selling them did not even cover the cost of the transportation!

Here, women farmers have lots of challenges. We lack access to land, and the men want to collect the money we get from farming. We have to hire the land from the men farmers. I am married and I have to rent land for myself and for my daughter. Other times they will say you will go to bed hungry and you will go to bed without eating.

I am married and I have to rent land for myself and for my daughter.

Men also want women to work on their farms, and take advantage of women when they hire them. Only on those days will they give women something to eat.

Women farmers should be given land so that we can farm. Maybe the government will make a decree to give us access to land. We, the women, have to come together to have a common goal, and then we can go to the government and tell them that this is our problem.

With more access to land, we could rotate crops and get higher yields. The land women get to farm is usually degraded. Men don't think about the fact that women are farming in order to feed and educate their children, because the men in their households have not done that. There is no access to credit for women. You have to invest out of your own money.

For women, we have to wake up early, cook breakfast, go to the farm and work there, then gather wood on our way back from the field, and then come home to prepare the family dinner. Men go to their fields and then they come back and they have a rest. They even go out. As for the women, we don't have time. We are exhausted. But we still have to farm. You can't think about that.

With more access to land, we could rotate crops and get higher yields.

What I like about farming is that you control your own schedule. If you want to go to the field and work, then you can. But if you are tired, you can stay home for a day to rest.

I want the Nigerian government to help the small-scale farmer, to have access to new methods of farming, even if we have to pay for it. Also give them access to loans. As a farmer, I get no support from the government extension system. And when they come, we can't even understand what they are trying to teach us because they speak a different language. In the future, if government extension agents could speak local languages, that would improve the situation.

If one day, there was no food in the markets, then people would realize that farmers are also contributing to the well-being of the country.

Having education would help my daughter to live better and have more interest in what she's doing. If she could learn about new farming techniques then that would help her be a good farmer.

At times, it seems the things that we are doing are not appreciated. So I think to myself, let all of us farmers move to the cities. If one day, there was no food in the supermarkets and in the local markets, then people would finally realize that farmers are also contributing to the well-being of the country. When our children all go to the cities and buy food in the supermarkets, I will still be farming my piece of land. I will not stop farming because that is where my income is. Everything is there.

Susan Godwin is a Nigerian farmer who leads the small-scale farmers in her community and in four Nigerian states. She is also a woman leader in a faith-based organization, and was named Oxfam's Female Food Hero for the year 2012–13. Married with five children, Susan Godwin has farmed seven hectares in the Northern area of Nassarawa state for 12 years, where she cultivates yam and groundnut, complemented by maize and guinea corn.

PRIVATE VS. COMMUNITY: A VIEW FROM THE PERUVIAN ANDES

Alexis Nicolás Ibáñez Blancas, Researcher at Universidad Nacional Agraria La Molina

Indigenous farming could become a motor for conserving biodiversity, promoting ancestral knowledge crucial for climate adaptation, and building alternative development models based on local markets. That is, if communities can hold the water-hogging mining companies at bay.

In the southern Andes of Peru, three processes have shaped small-scale community-managed peasant agriculture, beginning with the agrarian reform of the early 1970s. The reform, which sought to engage rural Quechua and Aimara populations in the broader process of national change, envisaged community management not only of land, in particular agricultural land, but also of prairies, water, forests, and the rest of the components of the agricultural ecosystem according to the communities' worldview. Following several years of struggle by peasant and indigenous organizations, this approach was written into the Constitution of 1979, which established that peasant communities were "autonomous" regarding land use, and that their lands were "...not to be seized or reduced. They are inalienable..."

This was not as radical a stance as it may seem: back in 1920 the previous constitution had recognized indigenous communities as a collective entity. The agrarian reform of the 1970s recognized indigenous cultural diversity and reaffirmed several specific collective rights, including the right to ancestral languages, the rights to land and natural resources, and even the right to customary justice. Significant for smallholder agriculture were the recognition of ecosystems within communal territory, and the services provided by those ecosystems, as capital assets belonging to the community; also codified was the right to water.

The 1920 constitution recognized indigenous communities as a collective entity.

A second process occurred in the context of generalized crisis in the country during the 1990's. An effort, mainly driven by actors external to the community, was made to integrate peasant communities into the market, on the assumption that small-scale producers needed to break out of their self-sustained communities and establish market relationships with the rest of the country. The productive system was seen as a constellation of small enterprises that ought to be linked by market relations. The political agenda derived from this conception called for increased investment in five areas: technology, credit, technological education, specialized technical assistance, and joint marketing.

The third process grew out of a different approach: the concept of well-being, whereby notions of growth and the market are set within a commitment to live in harmony with Mother Earth. This vision, perhaps best expressed at the "Summit for the Rights of Mother Earth" in 2010, entails a rupture with the development model based on growth and accumulation, and an embrace of balance between humans and the other key actors in the world. It recognizes that there are many ways of seeing the world, given our diversity; it acknowledges the value of ancestral wisdom and its specific local application; and it recognizes the earth as a subject with rights that is essential to life.

There are many ways of seeing the world, given our diversity.

Coming out of these three processes, peasant agriculture will confront three great drivers of change:

1. expansion of mining activity to the detriment of grazing land and in some cases of complementary cropping land at the highest altitudes;
2. climate change, which will affect the flora and fauna in the plateaus of the high Andes and the *Puna* ecosystem, which may well become more desert-like; and
3. huge conflicts over water, in a context where people lose their human right to water and therefore their access to it—through wetland loss and through investment in large dams,

placing water management increasingly in the hands of the private sector—resulting in an exodus of families that now live from herding alpacas.

Such challenges will shape ongoing efforts to affirm cultural identities, as in the case of the Aimara nation in the Puno high plateau, or the Chanka nation in Andahuaylas. It could also build more solid bridges for the “knowledge dialogue,” *Iskay Yachay* in Quechua and *Paya Yatiwi* in Aimara, which seeks to address the main problems associated with the loss of ecosystem services, and to contribute to sustainable management of the Andes via the continued practice of peasant agriculture, which generates valuable knowledge.

Small-scale agriculture’s role within the prevailing development model will come into conflict with large-scale investment.

Given these changes, in the near future, small-scale agriculture in the southern Andes will likely be relegated to a subsistence level, with an impoverished Quechua and Aimara population focused mainly on supplying food to intermediate cities, due to the displacement of the rural population to these cities. Small-scale agriculture’s role within the prevailing development model will come into conflict with large-scale investment, particularly regarding access to water. Nevertheless, if social movements for cultural affirmation manage to achieve their goals, smallholder agriculture could become a driver for the conservation of biodiversity, a powerful unifying force for replicating ancestral knowledge, a storehouse of experience for adaptation to the global crisis, and an alternative to the current development model.

Here are three possible scenarios for the future:

Scenario 1: A highly privatized agricultural system would have extensive areas dominated by mining activities in conflict with peasant populations, large infrastructure projects for water storage under private management, and the loss of wetlands and ecosystem services in the high plateaus and *punas*. Large-scale social fragmentation would make for conflict between cities and rural populations. Even if investment could ease life in the cities, the differences between higher-income groups and those living in peri-urban and rural communities would increase. The rural population would be a lot older and a lot smaller. In this case, the role of smallholder agriculture would be limited by restricted access to ecosystem services. Its function would be mainly subsistence, and the ancestral populations associated with it would be excluded from national development.

Scenario 2: A segmented agricultural system would see the rural population still in conflict with mining activities and water control initiatives, and a lack of alliances with cities would worsen the impact of climate change and the loss of ecosystem diversity. The relationship between cities and rural communities would only exist through commerce. Cities may achieve higher technological levels and the main activities and livelihoods may become automated.

In order to reduce conflict, there may be strategies similar to payment for environmental services or monetary resource transfers to rural populations. In this scenario, the role of small-scale agriculture would be supplying food to the intermediate cities. The local population would remain in poverty and dependent on resource transfers from public programs, with a limited role in the preservation of diversity and implementing only isolated initiatives to adapt to the global environmental crisis.

The knowledge dialogue could help overcome the tensions between Western culture and local worldviews based on the rights of Mother Earth.

Scenario 3: A more culturally diverse system would be managed at the local level by consolidated ancestral nations linked to each other through intermediate cities, such as Cusco, Juliaca, and Huamanga. Local production in the lower-altitude areas would focus on alpaca and mixed flock herding, linked to the water cycle, thus allowing for adaptation to climate change. Purely private activities would be scaled back. The knowledge dialogue would help overcome the tensions between Western culture (and its development model) and local worldviews based on the rights of Mother Earth. Smallholder agriculture would provide elements for an alternative development model, empowering the preservation of diversity and providing strategies and

experiences for adaptation to the global environmental crisis. It would generate new routes to knowledge based on ancestral wisdom and the knowledge dialogue. Small-scale agriculture would become a profitable activity that allows families sustenance and choices for their future development.

Alexis Nicolás Ibáñez Blancas is a Researcher at the Centre for Research in Arid Areas and a visiting professor in applied ecology at the Universidad Nacional Agraria La Molina in Peru. He specializes in topics related to the preservation of biodiversity, sustainability, and the development of peasant communities in the Andes. He has broad experience in international cooperation related to education programs and projects in rural areas of Ecuador, Peru, and Bolivia.

GROWING A MORE FOOD-SECURE WORLD

Harold Poelma, Managing Director of Cargill Refined Oils Europe

An agriculture that is resilient and sustainable, and provides sufficient safe, affordable food for all, will be built on four cornerstones: comparative advantage, open trade, markets that work for both producers and consumers, and an African continent that contributes positively to food production.

There are about 870 million undernourished people in the world today. There will be two billion more people on the planet by mid-century. Most believe feeding this more urban and more affluent population will require increasing food production by an estimated 70 percent.

Such a production increase is not out of reach. Farmers are smart and determined people – they have roughly doubled the amount of grains, rice and oilseeds they produce since 1975. Most of that increase has come from yield gains enabled by a combination of improved genetics, new technologies, better agronomics and increased intensification – producing more on essentially the same amount of land.

This is reason for optimism. Cargill believes there is no doubt we can feed the world. Our analysis is not just a theoretical desk-top view but one based on our practical experience working with farmers in our operations around the world. It is demonstrably true that with *current technology* the world's farmers today harness the power of photosynthesis to produce all the calories a world of 9 billion people will require.

With current technology the world's farmers today harness the power of photosynthesis to produce all the calories a world of 9 billion people will require.

Despite these facts, food insecurity persists. The calories the world's farmers produce are unevenly distributed. Rising food prices, primarily the results of issues of supply and demand – and this year in part due to shortages caused by droughts in key grain-producing areas – threaten to undermine recent reductions in hunger.

What must agriculture look like at mid-century to overcome obstacles to global food security? At Cargill, we believe the model that will meet the objectives of being resilient, sustainable and providing sufficient safe, affordable food for all will be built on four cornerstones: comparative advantage, open trade, markets that work for both producers and consumers, and an African continent that contributes positively to food production.

Producing enough food to feed the world starts with honouring the principle of comparative advantage. Mid-century agriculture will produce the most food in the most economical and environmentally sustainable way if all farmers plant the crops best suited for their growing conditions. This recognizes a simple fact: fertile soil, abundant rain and plentiful sunshine are not equally available across the planet. Rather, nature has endowed certain geographies with the natural resources necessary to produce a surplus of calories in the form of, for example, wheat from the plains of North America, rice from paddies in Southeast Asia or soybeans from Brazil.

The alternative – the pursuit of food self-sufficiency at a national or regional level – undermines the increases in output a growing global population will require, inefficiently uses scarce natural resources and can cause significant environmental harm. We must continue to improve productivity and importantly bring best practices and technologies to those areas of the world, such as Africa, that currently are not fulfilling their agricultural potential.³⁴

³⁴ Around the world Cargill is teaching better, more sustainable farming practices to farmers, many of whom are smallholders. For example, in West Africa we are helping strengthen local farmer organizations and providing essential support that is enabling tens of thousands of cocoa farmers to get higher yields, better quality crops and raise their incomes.

A resilient, sustainable mid-century agricultural system will also require an open, trust-based trading system to move surpluses to places of food deficit. Today, only about 15 percent³⁵ of all the food produced in the world crosses international borders. That percentage will increase. Global population growth is skewing toward areas that are not blessed with the natural resources required to produce food. Growing crops where the soils and climate are best suited for them and allowing open trade will provide the food that is needed, while minimizing overall environmental impacts by reducing the resources and inputs required.

Consider what has occurred to food flows in roughly the last fifty years. Increased food production in North and South America and lately Eastern Europe is providing the food required to feed the growing populations in Asia, the Middle East and Africa. To feed 9 billion people by 2050, we will need another strong food producer like Brazil, as well as open trade so the surpluses flow readily to areas of food deficit. Open and trust-based trade is also a primary means to help offset inevitable but unpredictable crop failures. The *global* supply of food varies less year-over-year than the *local* supply.³⁶

Producing enough food to feed the world starts with honouring the principle of comparative advantage.

A third cornerstone will be efficient, transparent and well-regulated markets. The combination of open trade and efficient markets results in prices that signal farmers about what and how much to produce. A price that adequately rewards farmers for their efforts and provides enough money to motivate them to produce again next year is the fundamental ingredient of sustainable agriculture – arguably more important than any other crop input.

By contrast, interfering with the behaviour-changing power of price can have unintended consequences. When governments impose price controls on commodities, ostensibly to protect the urban poor, they inadvertently send a signal to their farmers to produce less. Other means to protect consumers from food price increases, such as direct payments from governments, would be less damaging to agricultural interests. While acknowledging the burden of rising food prices on the world's poor, we must also recognize the energizing power of price to motivate the world's producers to plant more crops.

The fourth cornerstone that will enable a more food-secure world is an African continent able to exploit its agricultural potential. Africa represents about 60 percent³⁷ of the potentially available cropland in the world. It has land well suited for agriculture, with fertile soil, adequate rains, plentiful sun. Yet Africa is a net importer of food and has experienced very low agricultural productivity gains over the last forty years.

A third cornerstone will be efficient, transparent and well-regulated markets.

It doesn't have to be this way. Changes in policies, improvements in infrastructure and the institution of property rights will be required to overcome the challenges. Clarity about property rights is particularly crucial. Farmers in Africa – and everywhere, for that matter – must have clear rights over the land they cultivate before they can be expected to reinvest in their operations and improve their productivity. Similarly, resolving property rights issues is critical to attracting private sector investment in African agriculture.

Enabling smallholder farmers to fulfill their potential is crucial to the continuing development of agriculture and to global food production. These small-scale farmers need access to better crop inputs, from seed and fertilizer to tractors and other technology, and training in how to use them. Such practical support

A resilient, sustainable agricultural system that produces enough food for all at a price that can be borne by all is within reach.

35 <http://www.ers.usda.gov/data-products/agricultural-outlook-statistical-indicators.aspx>

36 For example, after frost damaged a major portion of the white corn crop in Mexico, Cargill visited farmers to estimate crop damage, then found ways to supplement the local crop with white corn from South Africa and the United States. We imported yellow corn for use as animal feed, freeing up white corn to be used in making tortillas, a staple of the Mexican diet.

37 http://www.mckinsey.com/Insights/MGI/Research/Productivity_Competitiveness_and_Growth/Lions_on_the_move

will increase their productivity in support of our growing worldwide food needs and it will also provide them with means to raise their own living standards. This is no more evident than today in Africa.³⁸

There is more momentum than ever to tackle policy, infrastructure, crop input and property rights issues in Africa. With the support and involvement of the G8's New Alliance for Food and Nutrition Security and the Grow Africa partnership, the private sector, non-government organizations and African governments are working to develop sustainable markets for food grown on the continent.

In May 2012, Cargill was among 30 multinational companies announcing support for these initiatives, which we believe will foster policy discussions and commitments to accelerate investment and transformative change in African agriculture. The collective intent is to work with governments and non-government organizations to develop public/private partnerships to make change happen.

A resilient, sustainable agricultural system that produces enough food for all at a price that can be borne by all is within reach. This does not mean there is room for complacency. We believe it remains essential that organizations, both public and private, continue to work together to provide the structure, support and investment that will contribute to agricultural development that can meet the challenge of feeding a world on its way to 9 billion people.

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³⁸ For example, tens of thousands of smallholder farmers in Zambia depend on the income they receive growing cotton to feed their families. But the land has been worked a long time, and harvests can be poor. Through more than 1,600 field schools, Cargill helps educate farmers about affordable and sustainable practices that improve soil quality, raise yields and lift incomes. We also encourage rotating cotton with food crops, which provides more nutrition at home. We have set up over 800 Cargill Cotton Women's Clubs in Zambia to adapt training specifically for over 16,000 women and to help overcome the cultural and social barriers that many women farmers face. Our pre-planting financing has helped 94,000 smallholder farmers in Zambia and nearly 29,000 smallholder farmers in Zimbabwe purchase seed and fertilizer that result in better yields and quality.

GENDER EQUALITY: IT'S SMART AND IT'S RIGHT

Madiodio Niase, Secretariat Director, International Land Coalition (ILC)

While farming is increasingly reliant on women's labour, women's lack of secure land tenure severely limits their influence over farming decisions. Closing the gender gap in land rights would increase productivity and total output. And it would help women exercise their rights as citizens.

Women provide a significant share of agricultural labour in developing countries: FAO says 43 per cent³⁹; UNIFEM says 60–80 per cent^{40,41}. These figures, although sometimes debated⁴², are a plausible illustration of reality and are part of a trend towards the increasing feminization of farm labour.

This trend is likely to continue and even accelerate as a result of a higher proportion of male outmigration, coupled with the high incidence of diseases such as HIV and AIDS. An increasing number of widows and female orphans will become heads of farm households and the main providers of family farm labour.

Women's increasingly central role in agricultural production is at odds with their still limited access to secure tenure rights over the land they farm. It is estimated that fewer than five per cent of women in the developing world have access to secure land rights, with significant differences from country to country (FAO 2011; UNIFEM n.d.). Where women enjoy secure tenure rights, farm sizes tend to be much smaller than is the case for farmland controlled by men.

Women's increasingly central role in agricultural production is at odds with their still limited access to secure tenure rights over the land they farm.

In Burkina Faso and Benin, a World Bank study found that the average sizes of women's land holdings were just 12.5 per cent and 50 per cent, respectively, of men's holdings.⁴³

If tenure security is achieved when community or individual rights over land are publicly recognised and rights holders are protected against arbitrary deprivation and enjoy the economic benefits attached to their land rights⁴⁴, then tenure security is a social construct whose meaning varies depending on socio-cultural contexts.

Therefore, the effectiveness of means (legal and otherwise) for guaranteeing tenure security depends on the context. Land ownership can be a means of achieving tenure security, but it is rarely a sufficient condition or the only way of securing land rights.⁴⁵

While the agriculture sector is increasingly reliant on women's labour, women's influence over farming decisions is limited due to their lack of land tenure security. This is why closing the gender gap in access to secure land rights makes good sense from an economic standpoint, as well as from the perspectives of social justice and human rights.

39 FAO. 2011. *The State of Food and Agriculture. Women in Agriculture. Closing the gender gap for development*. Rome: FAO. <http://www.fao.org/docrep/013/i2050e/i2050e.pdf>

40 UNIFEM. "Securing the Rights and Livelihoods of Rural Women in Africa in the Context of the Food Crisis and Climate Change". No date. New York.

41 Foresight. 2011. "The Future of Food and Farming: Challenges and Choices for Global Sustainability. Final Project Report". UK Government Office for Science. London.

42 Doss, C.R. 2009. "If women hold up half the sky, how much of the world's food do they produce?" Paper prepared for 2010 FAO State of Food and Agriculture. Mimeo.

43 World Bank. 2011. *World Development Report 2012. Gender Equality and Development*. World Bank. Washington DC.

44 Flintan, F. Forthcoming 2012. *Who's Eaten the Land? Concepts and Analytical Framework for Investigating the Linkages Between Land and Food Security*. International Land Coalition. Rome.

45 In this note we use the term "tenure security" in its broader meaning, although the statistics used often refer to it exclusively as land ownership.

Increased productivity and total output of the agricultural sector would be one of the more direct and tangible results of closing this gender gap, as equitable access to land is strongly associated with improved efficiency in the farming sector⁴⁶. Security of tenure contributes significantly to creating the incentives needed for increased agricultural investments, which leads in turn to higher productivity.

The 2011 Foresight report gives an example from Burkina Faso, where the productivity of female-managed plots was 30 per cent lower than that of male-managed plots, primarily because labour and fertilizer were more intensively applied on men's plots.

Women's lack of control over land is compounded by the obstacles they face in the various segments of the agricultural value chain – access to input services, extension services, processing, markets, etc.

FAO argues that closing the gender gap in agriculture would increase average crop yields some 20–30 per cent on women's lands, equivalent to a 2.5–4 per cent increase in domestic food production, and a 10–20 per cent decrease in the number of undernourished people worldwide (100–150 million out of 950 million people).

Evidence from around the world shows that when women have more influence over economic decisions (as is the case when they have secure land rights), their families allocate more of their incomes to food, health, education, children's clothing, and children's nutrition.

Achieving gender equality in land ownership would empower women and give them greater influence over the way that land is used.

Addressing the gender disparities in land access would also help improve rural women's social inclusion and identity. Having a land title often means having a physical address and thus access to birth certificates, identity cards, and voting documents, all of which are indispensable if women are to exercise their citizens' rights and take part in debates on issues of common interest.

Achieving gender equality in land ownership would empower women and give them greater influence over the way that land is used (what, when, and how to produce) and how farm products are used or disposed of.

The current inequities in land access also raise a human rights issue^{47,48}. The Universal Declaration of Human Rights recognizes the right to property for all. This includes the right to land, which is the most important physical asset in poor agrarian economies. The Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW) calls for equal rights of both spouses in terms of the ownership, acquisition, management, administration, enjoyment, and disposition of household property (Article 16).

In addition to international norms calling for fairer gender allocation of resources—examples include the already cited CEDAW but also the recently adopted Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests—many governments have adopted land-related laws which often have progressive provisions for addressing gender inequities. According to the World Bank, 115 out of 124 countries studied specifically recognize women's and men's property rights on equal terms.⁴⁹

46 Jayne, T.S., D. Mather, and E. Mghenyi. 2005. "Smallholder Farming in Difficult Circumstances: Policy Issues for Africa", in International Food Policy Research Institute (IFPRI). *The future of small farms: Proceedings of a research workshop*, Wye, UK, June 26–29, 2005. Washington, DC. pp.103-123.

47 Sida. 2010. "Quick Guide to What and How: Increasing Women's Access to Land". Swedish International Development Agency (Sida). Stockholm.

48 GLTN. 2008. "Secure Land Rights for All". UN-HABITAT/Global Land Tools Network (GLTN). Nairobi.

49 UN Women. 2011, based on the World Bank's Women, Business and the Law Database. UN Women. 2011. "In Pursuit of Justice, 2011–2012 Programme on World's Women". UN Women. New York. <http://progress.unwomen.org>

Why then are we not seeing broad-based rapid progress? Part of the answer lies in the fact that the cultural, religious, and social norms and beliefs that confine women to secondary decision-making roles are among what Roland calls “slow-moving institutions”⁵⁰ that contain and delay social change. Gender disparities in other key areas such as education and reproductive health also prevent women from fully benefiting from the opportunities created by progressive land policies, where these are adopted.

Many governments have adopted land-related laws which often have progressive provisions for addressing gender inequities.

Even in contexts where there are well-intentioned policy makers, the number of practical, low-cost, and culturally acceptable means of addressing gender inequities in the allocation of key productive assets such as land is limited.

A number of promising innovations for improving women’s access to land are being tested. For example, Ethiopia, Rwanda, Colombia, Peru, and Nicaragua have introduced joint land titling for spouses. In Nepal, a tax exemption (of 10 per cent in 2008, subsequently increased to 25–40 per cent) helped raise the number of households reporting women’s access to land ownership from 11 per cent in 2001 to 35 per cent in 2009⁵¹.

These measures are, however, more relevant in contexts of state-led redistributive land reform processes than in contexts of market-led reforms. Where an open land market exists, the risk of widening gender inequalities in land access can be reduced by establishing land funds or land banks (as in Colombia or Nicaragua), which provide financial support to women to purchase land or to pay land title registration fees.

These measures are seldom envisaged without strong pressure for change, starting with efforts to raise the awareness of decision makers and the general public on the rationale for, and benefits of, achieving gender justice in land access. Targeted land literacy (focusing on the land-related laws and institutions) can help women better understand their land rights.

Support for women’s land claims, strengthened women’s roles in land rights movements, and keeping land issues high on the agenda of the most influential global women’s organizations are all areas where organizations like mine, the International Land Coalition, have a key role to play in the future.

Addressing gender inequalities is also an obligation in pursuing the fulfilment of fundamental civil and political rights.

Addressing gender inequalities in access to secure land rights is justified from an economic point of view—the 2012 World Development Report refers to this need as “smart economics”. It is also an obligation in pursuing the fulfilment of fundamental civil and political rights, as well as social and economic rights.

A better understanding of intra-household resource allocation and governance, as well as documentation of good practices, could help serve as the basis for more relevant, better targeted, and more easily implementable policies and laws. Academic institutions, development agencies, and civil society advocacy organizations all have a key role to play.

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50 Roland, G. 2004. “Fast-Moving and Slow-Moving Institutions”. CESifo DICE Report 2. pp.16-21. <http://www.ifo.de/portal/pls/portal/docs/1/1193608.PDF>

51 ILC. 2012. “How Can Women’s Land Rights be Secured? Synthesis of the online discussion”. International Land Coalition. Rome. http://www.landcoalition.org/sites/default/files/publication/1242/ILC%20CSW%20online%20discussion%20synthesis_EN.pdf

THE FUTURE OF AGRICULTURE IS THE FUTURE OF MOTHER EARTH

Tarcila Rivera Zea, Director of the Centre for Peru's Indigenous Cultures (CHIRAPAQ)

Nothing is as ironic as the fact that we indigenous peoples, who brought so many foods to the world, lack the means to escape poverty and malnutrition. Having control over what we produce, how and when we do it, and power over its distribution will allow us to build sustainable livelihoods. We call that food sovereignty.

For the women and men who work the land to have complete and equal control over the resources they need and the food they produce, a series of conditions would have to be met. Without them, any attempt to think about that scenario would be pointless.

Control over the economic, social, and political resources that make production economically feasible and sustainable—and then turn that into livelihoods that allow producers to support themselves—means having the power to decide how those resources are used. At this moment indigenous peoples do not have that power. However, before exploring how we might get there, let's be clear about who the actors are in this drama.

Peasants and indigenous people

In our society, a strong social distinction has been drawn between peasants and indigenous people, whereby being a peasant is viewed as better than being indigenous. People often understand indigenous as “Indian” or “cholo”, words that convey social and cultural scorn. “Peasant” refers to an occupational category, whereas “indigenous” means a social condition. In this sense, while it is true that a large proportion of peasants are indigenous, in practice they are not the same thing, a distinction that gets translated into laws, policies, and people's perceptions.

The word “peasant” refers to a job, and the economic aspects predominate over any holistic link to the land. One can be a peasant and practice agriculture using industrial inputs or other methods that damage the land. In contrast, “indigenous people” refers to a cultural totality in which agriculture is an important part of our daily activities and reflects different social, spiritual, economic, and political relations.

In our society being a peasant is viewed as better than being indigenous.

Indigenous agriculture is based on ancestral knowledge and practices, which ensure genetic diversity according to the varying geography and in response to different climatic, environmental and social conditions. Evidently, indigenous people use industrial inputs, given market pressures and the lack of alternatives to respond immediately to the climatic impacts, which range from pests to water shortages. But ancestral practices for managing land, water and climate variances are gradually coming back, a process we call “indigenous geographies.”

From the perspective of indigenous peoples, agriculture ought to be the foundation for sustainable land stewardship, as well as a source of food sovereignty and of germ plasm diversity, which has proven useful for combating malnutrition.

Indigenous agriculture is based on ancestral knowledge and practices, which ensure genetic diversity according to the varying geography.

Building the present

At this time, indigenous organizations are developing different models of farming based on our cultures, with the intent of drawing from them concrete proposals for building sustainable livelihoods. During this process, control over the resources needed to make these proposals viable is of utmost importance.

We are completely conscious that any solution must emerge from the encounter of our cultures and traditions with global cultures. This dialogue between cultures must take place under conditions of equality and that is the scenario we are working toward. It is why we talk about “farming systems” and not about transposing our culture to all of society.

If indigenous peoples gain complete and equal control over farming resources and over the food produced, the situation that would arise would be utterly without precedent in our history as part of the global system. It would mean for our societies:

At the ecological level:

- Living things would be raised with respect for the land’s natural ways of renewal;
- Biodiversity would fit the different geographies and support sustainable harvests;
- Production would be based on smallholdings, linked by production chains that would allow them to supply local and regional markets;
- People would have a rich, healthy and diverse diet;
- Diversified food systems would exist; and
- Biodiversity would be strengthened, given that agro-ecological pest control would reinforce native biological chains.

If indigenous peoples gain complete and equal control over farming resources and over the food produced, the situation would be utterly without precedent in our history as part of the global system.

At the social level:

- The conflicts and social divides that have characterized our societies would be healed;
- Agricultural work would be considered dignified, and the role of indigenous peoples would be redefined;
- The social value of labour in organic and sustainable production, in harmony with nature, would be reinforced;
- Indigenous peoples would see a substantial improvement in income and living standards, which would allow them to invest more in education and professional training to improve indigenous economic systems; and
- Food sovereignty would be achieved, with livelihoods based within different geographical spheres and linked to complementary activities, such as traditional fishing and herding.

At the political level:

- Decision-making power over production and marketing would bring substantial changes to the economic system regarding land tenure, with the right to territory as a cornerstone;
- Countries could proceed to change the social and political paradigms they live by; and
- Indigenous peoples and agriculture would be at the heart of the design, content, and rollout of national sovereign efforts to achieve internal development.

Our vision for the future puts us in a scenario where the divide between indigenous and non-indigenous peoples will no longer exist. Indigenous peoples will have improved their living conditions by producing organically and in this way will have contributed to the recovery of ecosystems. Germ plasm diversity will be a guarantee of a diet rich in nutrients and suited to geographical locales. Production and distribution systems will feed the entire population.

Improvements in the quality of life of indigenous peoples would also contribute to strengthening the position of indigenous women as the ones who create and care for life.

Legislation and the constitution would reflect this new reality by securing territorial property rights and encouraging food sovereignty. The agricultural frontier could be broadened based on diversified production, where science and technology would help deepen indigenous knowledge so it can be applied elsewhere, respecting its spirit and style.

Improvements in the quality of life of indigenous peoples would also contribute to strengthening the position of indigenous women as the ones who create and care for life, placing them in positions of leadership and representation for our peoples.

Power to make sovereign decisions

This entire process can be summarized in the concept of food sovereignty. It implies in first place, control over production systems to be able to decide what, how, and when to produce, as well as control over the cultural environment in which that happens. It also implies control over what is produced and where and how that is placed in different markets. In recent decades, experiences show that such processes require an agriculture that is diversified and sustainable, one that respects Mother Earth.

CHIRAPAQ, the Centre for Peru's Indigenous Cultures, carried out a food sovereignty program during the decade of the 1990s in the region of Vilcas Huaman in Ayacucho. We did so right in the middle of the war that affected our country, and right in the war zone. It involved:

- Re-establishing diverse varieties of potatoes, corn, beans, and medicinal plants;
- Resurrecting farming methods and technologies, expanding farming into new areas, and establishing water sources;
- Renewing organic pest control methods and fertilizers that have increased yields and diversified family diets;
- Reintroducing native small animal species;
- Improving the nutrition of participating families, with a consequent improvement in school performance of boys and girls;
- Strengthening community organizations;
- Valuing and making evident the work and contribution of women and girls.

The primary basis of this initiative was the linking of traditional farming cycles, water management, and the in-the-field improvements of the crops cultivated. While it is true that improvements in nutrition and in the quality of life of the communities involved in the program were achieved, the scope was still quite limited.

Between reality and potential

According to the latest studies, food insecurity is concentrated in regions where indigenous peoples live and in poor urban communities made up mostly of indigenous migrants and their descendants. Nothing is as ironic as the fact that indigenous peoples, who provided the world with so many different kinds of foods, do not have the means to use our knowledge to escape from malnutrition and poverty.

To speak of the future of agriculture is to speak of about the future of the earth, of indigenous peoples, and of humanity as a whole.

We indigenous people have been building mechanisms to address our poverty, but the central issue – power – requires structural changes in our societies, regarding who belongs, who contributes to development, and what development models and economic systems can make society viable.

It is not mere rhetoric to say that a *pachacuti* (big change) is needed to transform our situation. The world as a whole needs a paradigm shift, and in the current circumstances agriculture – as a visible expression of our love for Mother Earth – shows us just how hard this will be. To speak of the future of agriculture is to speak of about the future of the earth, of indigenous peoples, and of humanity as a whole.

Tarcila Rivera Zea is Founder and Executive Director of CHIRAPAQ (Centro de Culturas Indígenas del Peru), a leading organization that promotes the rights of Peruvian indigenous peoples. She has dedicated more than 20 years to the fight for the recognition of indigenous peoples and cultures in her country. In 2012, she was named to UN Women's International Advisory Group on Civil Society.

FARMERS DO NOT COME FROM MARS

Julio A. Berdegué, Principal Researcher, Latin American Centre for Rural Development (RIMISP)

If poor farmers had more freedom to innovate and adequate access to public and private investments, they would likely disappoint us by getting out of farming altogether. But even if only one or two in five remained, they would change the world for the better, literally.

Resource-poor farmers are not Martians. Like you and me they make decisions that are largely informed by their culture, their capabilities, and the set of incentives (positive and negative) they face. The question that Oxfam asked me to answer invites us to think about a world in which the capabilities of the farmers have been greatly expanded and the incentives they face have been redefined in ways favourable to them.

Amartya Sen would say this is what development is all about, attaining “the freedoms of people to lead the kind of lives they have reason to value.”

What would resource-poor farmers do with that freedom to innovate? Probably we would see about 500 million different answers, one for every smallholder on the planet. We need to recognize that that is just fine, because very often those of us who look at poor farmers from afar, tend to have strong preconceptions of who we would like resource-poor farmers to be in a better world that we have built in our minds.

If these farmers had more freedom to innovate, many of them very likely would disappoint us, leading lives that they have reason to value and that are probably quite different from those that we, external observers, would like to see them valuing.

What would resource-poor farmers do with the freedom to innovate? We would see about 500 million different answers, one for every smallholder on the planet

To begin with, many of them would move to cities. If they really had a lot of freedom, some would even move to other countries. However, if before deciding to move they had adequate access to public and private sector investments in support of their innovations, if they moved for sure it would be because they would value that option, and not because poverty, hunger and social exclusion expel them from their birthplace.

Others would remain where they've always lived, or nearby, but would gradually become only part-time farmers, or even get out of farming. They, or their children, would become traders, shopkeepers, artisans, professional singers... or doctors and engineers and, God save us, MBAs or politicians. With such diversity they would enrich the social, cultural and economic fabric of their villages and of the nearby towns and small cities. Richer, better rural societies would be the result.

Finally, some would continue to be farmers. I believe that they would be a minority of the 500 million that we started with. And that is also perfectly fine. If they were capable of bringing their ideas to fruition because they have adequate access to public and private investments, even if only 100 or 200 million remained in farming, they would change the world for the better, literally.

Think about it: As farmers, what would they seek to achieve through their innovations? Probably they would seek to produce more, and to do it in ways that allow them to become the preferred choice of the buyers of their products and, ultimately, of the consumers. I think that they would value innovations that put more cash in their pockets, so they can buy the goods and services that are part of the lives they have reason to value and that they cannot produce themselves or exchange with their neighbours.

Farmers would value innovations that put more cash in their pockets,

They also would probably like to work less, or better said, to ease the huge physical exertion that is today associated with the life of the resource-poor farmer; that would allow them to live fuller, more humane lives. And, finally, I believe they would also like to be far less dependent on the political masters that today use their control of varied resources to condition farmers' choices as citizens.

I am quite sure that almost all farmers would seek these four outcomes of innovation, because, after all, farmers are not Martians.

Yes, you must be asking, what about natural resources? Well, I am not as certain that most resource-poor farmers would chose to use less water, or fewer pesticides, or adopt soil-conserving technologies, under the "What if..." conditions of almost unlimited freedom from constraints that is implied in Oxfam's question.

I would hope that many would, but I am not sure. You see, several of the four outcomes of innovation that I believe most farmers would seek if they had a chance and that I listed in the previous paragraph, in many circumstances are contradictory to conserving nature. Would they sacrifice income, or production, or less physical exertion, if it were necessary to avoid a negative impact on the environment? I am not sure they all would.

How, then, could society incentivize resource conservation so it is aligned with farmers' probable preferences? We return to the start of this note: I believe that smallholders' decisions are largely informed by their culture, their capabilities, and the set of incentives (positive and negative) they face. Those are the three possible entry points for policies and programs that seek to incentivize and support resource-conserving livelihoods.

But let me insist that smallholders make their living by **using** natural resources, and for them to use those resources in ways that are better for nature, they must be able to see the benefit of such a course of action; simple coercion does not work in the long run and, to start with, smallholders are already coerced enough by so many forces that they really do not need any more of that.

A fundamental starting point is that society should secure the effective exercise of the most basic rights of smallholders as human beings, such as the right to food and to lead a healthy life, or the rights of women in smallholder households to make informed decisions by themselves and act upon them. This can only lead to a better relationship between smallholder communities and nature around them, because the expansion of such rights can remove or ease many of the reasons why smallholders may use natural resources in unsustainable ways.

Would farmers sacrifice income, or production, or less physical exertion, if it were necessary to avoid a negative impact on the environment?

In second place, society can also improve the ways in which smallholders use natural resources by making available some goods and services that many of us take for granted but that many farmers lack in full or in part: roads and better access to cities, fairer and more transparent markets, enforcement of labor laws and regulations (many smallholder households depend in part on wage labor which in rural areas often happens under appalling conditions), access to credit, and so on. Such "public goods" dramatically expand the range of options that smallholders have, and often reduce the relative attractiveness of activities that deteriorate the environment.

One "public good" that is often forgotten is political rights. Smallholders need to be able to exercise such rights if they are going to have the voice and power to control the access and use of natural resources that belong to them by law or by custom. If rural communities do not have a say in crafting and enforcing the rules that determine who uses those resources and how they are used, the end result most often will be misuse by those who may not have the right, but have the power.

In addition, collective action through community- or resource-based or economic organizations is a particularly powerful tool because it can open ways of using resources that are completely blocked for individual and isolated smallholders.

Smallholders deserve to be seen and treated as persons with equal rights, but also with duties and obligations.

Access to an expanded range of forms of knowledge and to resource-conserving technologies can also be quite effective, as long as those technologies also make sense to smallholders from a cultural and economic point of view.

However, I don't believe that the above types of actions are enough, because smallholders do have an incentive to use resources in ways that maximize their short-term, private interests. Like you and me, smallholders love birds and trees and beautiful flowing rivers, but as you well know, when it comes to human beings such love is not enough to prevent us from hunting the bird, cutting the tree, or diverting the river if we can derive a benefit and we can get away with it.

This brings us to my final message. Well-enforced laws and regulations that constrain certain innovations or that limit the use that can be made of resources are necessary. Smallholders deserve to be seen and treated as persons with equal rights, but also with duties and obligations. In the world of Oxfam's "What ifs...", smallholders are citizens, pure and simple. That is development.

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WORKING HARDER ISN'T WORKING

Rokeya Kabir, Executive Director of Bangladesh Nari Progati Sangha (BNPS)

Striving to produce ever more food is the wrong starting point for achieving food security. Instead, let's focus on reducing inequalities by giving small-scale farmers more control, valuing their knowledge, and removing barriers that hamper women's ability to farm on equal terms.

Every year it seems we have to relearn the hard lesson that producing more food is no guarantee of ending hunger. This decade, Bangladesh has gradually increased rice production, saving the national economy a significant amount of foreign exchange that once went to pay for imported rice. Thanks to our farmers and their backbreaking efforts, our leaders can now smugly proclaim, "We produce enough to feed the nation!" Or "The country has no food deficit!"

Sadly, this macroeconomic reality has not brought benefits to farmers themselves. In the low-lying region of the northeast, for example, around forty percent of households are still unable to eat two meals a day, even though the region is well known as centre of rice production. (Fishing is the other source of living for people there, but corruption and political influence in leasing systems deprive fisherfolk of access to many water bodies.)

Every year it seems we have to relearn the hard lesson that producing more food is no guarantee of ending hunger.

The problem is the imbalance between the price of food and the income of the poor. Bumper harvests were achieved by the state-sponsored use of new seeds, chemical fertilizers and pesticides. But those same innovations also raised production costs, even beyond what farmers can get for their harvests. Because small-scale farmers must borrow money to plant, this profit-loss imbalance keeps them locked in a vicious cycle of debt.

It is time to rethink the technology used in farming and related services to empower peasants to earn a living, feed their families and keep food prices affordable for all income groups. Let's start by valuing farmers' indigenous knowledge, experience and innovation, using a farmer-led approach to improve their natural resource base.

Investment in farmer-centric research for recovery and improvement of indigenous rice varieties should be the first step. The indigenous varieties of rice that made northeast Bangladesh a centre of rice production long before the introduction of foreign seeds have almost disappeared. The goal should be to free our farmers from dependence on the seeds of multinational companies and its local agents, including giant corporate-NGOs.

It is time to rethink the technology used in farming and related services to empower peasants to earn a living.

Once seeds are under farmers' control and their rights over them are guaranteed, farmers could regenerate and expand their biodiversity as they have for generations. Control over seeds is the lifeline of the farming community and strengthening farmers' seed system is essential for innovation and knowledge generation.

Planting indigenous varieties of rice and other crops would reduce costs with a positive impact on lives and livelihoods. It would lessen the use of chemical fertilizer and pesticides and augment the use of organic and environment friendly alternatives. Current production methods cost the ecosystem heavily, causing damage to soil quality and extinction of flora and fauna. It would also promote diversity: of species and crop varieties, of ecosystems and habitats, of knowledge and practice, even of relationships.

Farmers lost control over seeds at the same time that they lost control over other farming essentials, like fertilizer and pesticides. The Structural Adjustment Program led by the World Bank and bilateral agencies (particularly USAID) in the 1980s transferred public services for farmers from the state-owned Bangladesh Agricultural Development Corporation (BADC) to the private

In reality the new market system allowed private dealers who enjoy political backing to manipulate stock levels.

sector. This was done in the name of promoting competition, but in reality the new market system allowed private dealers who enjoy political backing to manipulate stock levels.

It's a similar story with ground water for irrigation. Farmers are dependent on local water lords who own the deep tube-wells in each locality, privatized under Structural Adjustment. The market control exercised by water lords is a key factor in high production costs, and the wells also contaminate drinking water with arsenic.

State subsidies for agriculture have not compensated for the stranglehold exercised by private traders. In fact, studies show that sixty percent of beneficiaries of subsidies are not poor, but rich landowners and non-farmer traders. The same is true regarding bank loans: the lion's share, which should be set aside for poor and landless farmers, goes to rich landowners.

Farmers have worked hard to increase food production, but the system is stacked against them.

These middle-men, rice mill owners and traders, also control the sales end of the market, offering farmers low prices at harvest time. Government and NGOs should facilitate farmers' cooperatives to market crops directly to consumers. That would ensure fair prices at both ends, for producers and consumers.

A more just agricultural system would also remove the particular barriers faced by women farmers. Our rural women are a major part of the farm workforce, yet are virtually invisible to family, state and society. Their unpaid contribution is not calculated in national GDP at all.

Close to half of all farmers in the nation are now women, as more men have left to look for jobs in the cities or abroad. However, to be eligible for government funding for farm supplies, farmers need an Agriculture Input Assistance Card (AIAC) to prove their land ownership, which many women can't get because the land is in their husbands' names. Without the cards, women farmers have to work much harder to put food on the table for their families.

It is a gross violation of the rights of these millions of women who are relentlessly working to increase the country's food production. No wonder a fundamental demand of the Bangladeshi women's movement is to reform inheritance laws so that women can inherit land. Such a step is essential for sustainable agriculture and food security too!

Our farmers have worked hard to increase food production, but the system is stacked against them. Working harder is not working. We need to change the system. Valuing farmers' knowledge, experience and innovation is the logical place to start.

Ms. Rokeya Kabir is Founder and Executive Director of Bangladesh Nari Progati Sangha (BNPS). She is a frontline activist for women's and human rights in Bangladesh, with more than thirty years of professional experience in the field. In recognition of her work, she was nominated as one of the "1,000 Women for Peace" for the Nobel Peace Prize for 2005. The BNPS is one of the principal women's organizations in Bangladesh and has directly served, since 1986, about 100,000 women.

FRAME NEW IDEAS WITHIN INDIGENOUS KNOWLEDGE

Dr. Florence Wambugu, CEO, Africa Harvest Biotech Foundation International (AHBFI)

Experts' ideas about how resource-poor farmers could improve productivity ought to be guided by indigenous knowledge. Low-cost, micro-innovations that make use of local resources have great potential but are often overlooked by mainstream developers of agricultural technology.

Although many people know me because of my frontline work in advocating for Africa's right to Genetically Modified (GM) technology, many don't know my early involvement in this technology was largely driven by the desire to increase agricultural productivity for resource-poor farmers. I remain true to my calling, but wiser to know that the GM technology is only one in the large arsenal of tools available to scientists and farmers.

There is, of course, a place for conventional technologies, but what I really wish to explore in this article is how "expert ideas" targeted to resource poor farmers need to be framed within the indigenous knowledge of technology recipients.

When HIV/AIDS robs a woman of her husband, does the widowed mother, now alone to take care of her seven children, have anything to contribute to her plight? Does the fact that she owns only one acre of land in Kenya's arid and semi-arid lands make her a mere recipient of development interventions? Could her experiences with the myriad of challenges provide a solution to her problems?

The mainstream drivers of agricultural R&D often fail to incorporate home-grown ideas and innovations into their interventions.

Sadly, the mainstream drivers of agricultural R&D often fail to incorporate home-grown ideas and innovations into their interventions. Forced by years of limited success, development players are now searching for how best to tap farmers' indigenous knowledge and innovations.

A case in point is a project funded by the International Fund for Agricultural Development (IFAD) and implemented by Africa Harvest. The Food Security and Ecosystem Management for Sustainable Livelihoods in Arid and Semi Arid Lands of Kenya (FOSEMS) Project, demonstrates how to unlock value by tapping indigenous ideas and innovations.

The project takes an integrated approach to food security, ecosystem management and sustainable livelihoods using five components: traditional food crops, horticultural crops, soil fertility management, water (conservation, harvesting and management) and short-cycle livestock.

They managed to increase their incomes by making small improvements with few resources.

The project location represents the poorest of the poor in the harsh arid and semi-arid environment of Makueni District and Central Kitui in the Eastern Province of Kenya. The communities depend on agriculture or agro-pastoralism for their livelihoods; they include subsistence farmers, traditional crop processors, livestock farmers, HIV/AIDS affected households, unemployed rural people and farm produce dealers.

At project inception, we were very conscious that among target resource-poor farmers, there existed indigenous knowledge and innovation. We were therefore on the lookout for farmers doing novel things to mitigate the challenges they faced.

Our staff (a multi-disciplinary team of scientists, sociologists, economists and field workers) joined hands with local communities and other stakeholders and pursued an approach we call farmer-first-and-last (FFL) and it has proven more effective than the often used alternative, the technology transfer (TT) model.

We started with a systematic process of understanding the conditions of farmers, and in consultation with farmer leaders developed home-grown adaptable solutions to resolve the challenges people faced. .

Farmers are innovators who generate agricultural practices which are very well adapted to the prevailing conditions.

These included unfavourable soil conditions, erratic rainfall patterns, low literacy levels, unstable market prices of inputs and final produce, and limited access to insurance and credit markets. While, some do own the land on which they farm, they lack productive assets acceptable as collateral. Research generally agrees that these farmers will be disproportionately affected by climatic changes and that trade reforms are not sufficient to reduce poverty among them.

These farmers are experimenters and innovators who generate their own agricultural practices which are very well adapted to the prevailing agro-ecological and socio-economic conditions. While not applying advanced systems of agricultural production, they managed to increase their incomes by making small improvements with few resources, expanding their resource base by building upon local knowledge.

Some of the farmer “innovations” included growing of dry-land cereals and legumes and also keeping short-cycle livestock to address food deficiency in local diets and income generation from marketing the surplus in the nearby shopping centres.

Farmers proposed the upgrading of their indigenous goats and chickens to improve their breeds for milk and egg production. Their explanation was that goats and chickens were more resilient to drought and climatic changes; their meat and eggs are a source of protein to improve human diet; goat droppings boost the fertility of gardens; and their sale provides much needed income for school fees, medical costs and farm inputs.

Farmers received an improved variety of chicks, which resulted in increased egg production. One of the indigenous innovations was the farmers decision to assign one of the mother hens to tend to the chicks of several mother hens; this released others hens used in brooding to resume egg production at the earliest opportunity.

During the baseline survey, women farmers identified water for domestic use as the highest priority and suggested sand dams could retain water throughout the year. Three sand dams across Muini River in Mulala, Kamunyii in Wote, both in Makueni County and Yethi River in Kitui were constructed and completed.

The community shares and manages this resource to ensure equity and sustainability. Innovative funding mechanisms would probably attract the private sector to play a greater role in the search for greater engineering innovation in building dams and providing domestic water.

It's impossible to achieve success alone.

A key lesson was that farmers must be involved in the search for solutions to their problems. Our farmers' idea of planting sorghum, which is a naturally drought-resistant grain crop allowed them to use a traditional innovation taking advantage of the minimal precipitation that occurs during the short rain season, thereby affording them a second harvest.

It's impossible to achieve success alone. With help from the Ministry of Agriculture's Home Economics Department, farmers became more innovative in making new recipes of tasty meals from sorghum grains. Younger farmers fed their surplus sorghum grain to the improved chickens and then sold eggs instead. The sorghum residue was also used as manure to fertilise the soil and as a fodder bank for consumption by livestock during the dry season.

You cannot underestimate the importance of building local capacity—nor the time it takes. A major contribution of Africa Harvest in the project was training, capacity building, skills transfer, especially in good agronomic practices, and information dissemination to farmers along the whole value chain.

The disadvantaged in society could be key drivers of development. Africa Harvest tapped into persons living with HIV/AIDS, youth, widows, orphans and men and women undergoing alcohol abuse rehabilitation. Appreciating and working with the disadvantaged helped to demonstrate in the fastest way that our interventions worked. This attracted other community members. The project also provides conclusive evidence that local knowledge can be built upon to successively stimulate and upscale processes of innovation, with one new idea spawning the next.

Tapping into the creativity and perseverance of poor farmers should be an integral aspect of project design, not an after-thought.

The integrated-approach to development can positively impact many aspects of community life. Tapping into the creativity and perseverance of Africa's resource-poor farmers should be an integral aspect of project design, not an after-thought.

Development partners could also emulate the example of IFAD by allowing some flexibility in project implementation while achieving project targets, encouraging farmers' innovations and allowing project promoters to focus on solving the problems facing the farmers, while still focusing on food security, income generation and sustainability.

For R&D organizations, the key lessons are that farmers and scientists are partners in development. For the FOSEM project, the two groups worked together to come up with a legume for nutrition and soil fertility: high-yielding dual-purpose cowpea from certified seeds whose tender leaves serve as a vegetable for human consumption, while the mature leaves form an important ingredient in chicken feed and the seeds provide a rich source of protein. Cowpea fixes atmospheric nitrogen and enhances soil fertility. Its residue is also used to feed goats and provide manure for the soil.

Overall, such micro-innovations bring improvements that tend to be low-cost, and because they primarily make use of local resources. These innovations are often overlooked by mainstream developers of agricultural technology. These innovations have good potential for dissemination and sustainability. Sadly, most of the innovators lack confidence and the means to make their ideas more widely known.

Florence Wambugu is Founder and Director of Africa Harvest Biotech Foundation International (AHBFI) and the Co-Principal Investigator of Africa Biofortified Sorghum Project (ABS). She is a renowned agricultural plant pathologist with specialization in virology and genetic engineering, and the author and publisher of *Modifying Africa: How Biotechnology Can Benefit the Poor* (www.modifyafrica.com).

THE FUTURE IS ALREADY HERE

Kavita Prakash-Mani, Head of Food Security Agenda, Syngenta International

The future has arrived, it's just not at the scale required. The spread of bottom-up approaches to farmer innovation, coupled with breakthrough technology developed by input companies, will make smallholders productive and profitable. Crucially, new technologies must be accessible, appropriate and affordable.

How can we develop smallholder farming in a way that is appropriate, equitable and helps to feed the 8 billion people who will inhabit the world in 25 years – including the 870 million who are hungry today – and still live within Earth's planetary boundaries? New models are already being developed and tested, some led by donors and NGOs, others by multinational food companies or small entrepreneurs, and still others by multiple players working together.

Successful examples of public–private partnerships can be seen in Brazil, Vietnam and increasingly in Africa. For example, the Grow Africa⁵² partnership platform that began in 2011, brings together governments from a number of countries including Ethiopia, Tanzania, Ghana, as well as donor agencies, local and multinational companies, and civil society organizations to invest in agricultural transformation by placing smallholders at the heart of development.

However initiatives like this are not enough. Much more needs to be done – and even more important, to be done at scale.

The technology debate

While farmers are stewards of their land and experts in their local cultivation practices, there is a role for other players and for technology to make the job of farming less hard, more productive, and more sustainable. Currently, there is disagreement on the impact of technologies and what intervention or techniques are appropriate. Will technology make the farmer profitable or will she get caught in a debt spiral? Will it create a dependency for the farmer or enhance farmer choice? Will it have a detrimental impact on the environment or conserve resources and ecosystems?

Will technology make the farmer profitable or will she get caught in a debt spiral?

Going forward, we foresee the need for 'hybrid' solutions tailored to different geographies, climates and crops. We see the debate moving on from the simple choice between organic versus technology-driven solutions to one where seemingly opposing approaches come together to create the most effective solution.

For example, conservation practices which protect soil and water will be enabled by the use of crop protection solutions, and may also result in a decreased use of fertilizers. Pressure from pests will be reduced by crop rotation and integrated pest management approaches, including the use of beneficial insects and biological controls. Certified clean seeds, bred for local conditions and able to withstand changing weather patterns, will result in much higher yields and use less environmental resources.

Farmers as innovators

Farmers know their land better than anyone else. They have learned over generations what works on their farms – which crops do well, what to plant and when, how to manage their soil and water. They can often be risk averse and slow to adopt new ideas, but they can also be innovative and come up with new, locally relevant, economically feasible solutions.

⁵² <http://growafrica.com/>

There is no doubt that farmers' innovations will need further support. Even now, according to the FAO⁵³, \$83 billion needs to be invested in agricultural research and downstream services, to support the development and scaling up of local knowledge and best practice.

We see a future where there will be greater emphasis on learning from farmers and more investment to enable farmers to develop their own approaches to such challenges as soil fertility, seed productivity, fighting pests and diseases, and climate change.

Greater government investment in local agricultural schools will make for better trained local scientists, agronomists and extension workers.

Greater government investment in local agricultural schools will make for better trained local scientists, agronomists and extension workers. Local universities will work with farmers to understand, catalogue and review the farmers' own practices and use of inputs – and, in turn, invest in further developing and disseminating local best practice.

Development of local capacity should also help address the lack of investment in orphan or neglected crops. These are locally relevant crops such as sorghum, tef and cassava, which form the dietary staple for many resource-poor farmers and their families, but have seen no investment in research and development to improve their productivity.

A bottom-up approach to innovation would be supported by multinational companies and research organizations through investment, training and student exchange. Donors would provide grants to local scientists and agronomists. Partnerships would be developed, like the Water Efficient Maize for Africa initiative⁵⁴, where the private sector, development agencies, public research organizations and local research institutes work together to develop drought-tolerant maize varieties suitable for the African region.

In the decades to come, there will be much more open-source innovation and knowledge sharing. All types of organizations, whether multinational companies, research institutes or local NGOs, will recognize local knowledge and disseminate it more widely – farmer to farmer, region to region. Innovative solutions shared through cloud sourcing and social media will enable farmers globally to freely access and share their own experience and learning. We know farmers learn best from other farmers. Geographic distance will not be a constraint in the future.

Geographic distance will not be a constraint in the future.

Such grassroots innovation should result in lower cost, locally applicable and globally adaptable solutions that also provide an economic benefit to the farmer innovator.

Technology that is appropriate, accessible and affordable

While bottom-up farmer-led innovation will make a substantial difference to smallholder productivity and profitability, farmers cannot develop all the solutions required. They will also need investment in breakthrough technology in the form of better seeds, fertilizers, crop protection, mechanization, irrigation and even better agronomy practices. Given the scale of investment required to develop such technologies, agriculture input companies will continue to play a critical role.

The challenge of how to make these inputs accessible, available and affordable for smallholder farmers will be addressed. For one, more farms will be profitable in the future and more farmers should have the income to access these solutions. But it is likely that there will be a subset of farmers who can't afford them or can only afford them through loans at very high interest rates.

53 http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Investment.pdf

54 <http://www.gatesfoundation.org/agriculturaldevelopment/Pages/water-efficient-maize.aspx>

In a profession that is plagued by disasters – environmental forces such as droughts or floods, or through pests and disease – the risk to the farmer is very high.

With more public investment in agricultural R&D, the cost of development could be subsidized. Newer techniques, such as marker-assisted breeding and precision agriculture, greater collaboration between public and private entities, open-source idea generation, virtual teams and collaboration, should all enable faster and cheaper technology development. Working more closely with the farmers themselves will enable companies to target more clearly identified needs and develop more appropriate responses.⁵⁵

More investment in infrastructure, clarity of regulation and opening of markets will in turn facilitate easier distribution of these technologies to those who need it most, even in remote areas – and not at exorbitant costs.

In addition, providing credit at fair terms, pricing products so they are affordable, enabling farmers to secure a purchase with affordable insurance to reduce their financial risk, setting up contracts for farmers to sell their products, are all methods being tested in the market now to enable farmers to access inputs and technology without high risk. Such financial solutions will be the norm in the future.

Working more closely with farmers will enable companies to target identified needs and develop appropriate responses.

In many ways, the future is already here. It's just not at the scale required to make a significant impact. While we need to invest in bottom-up innovative solutions as well as global technologies, we have to ensure that these are accessible, appropriate and affordable to the farmers who need them most. That's both the challenge and the opportunity facing us. Only then can we secure economic growth for 500 million smallholder farmers and achieve food security globally.

Kavita Prakash-Mani is Head of Food Security Agenda at Syngenta, an international company dedicated to the purpose of bringing plant potential to life. She is responsible for establishing a strategic agenda that embeds food security and sustainability into business activities. The current focus of her work is working with smallholder farmers to improve their productivity and profitability, and on environmental sustainability of agriculture. She is also a member of the World Economic Forum's Global Agenda Council on Food Security and Nutrition.

⁵⁵ For example, Syngenta is already working closely with rice farmers to understand their challenges in rice production and developing new solutions such as TEGRA – a new technology for rice that improves transplanting techniques, requires less labour and increases yields.

WHO WILL FEED US ALL?

Pat Mooney, Co-founder and Executive Director of the ETC Group

If we are to survive climate change, we must adopt policies that let peasants diversify the plant and animal varieties on our menus. Only they have the know-how and patience to find out what plants and livestock will thrive where. A fundamental change in the regulatory machinery is needed.

There has been a Pavlovian conviction that agricultural technology can meet our future food needs – and a pathological denial that industrial agriculture has contributed to today's food crisis. Now, with climate change, the Global South's food insecurity has morphed into a shared global challenge. Even soil-rich nations may not have the weather, water and other resources to feed themselves in 2050.

Policy makers are conventionally offered two options: the high-tech industrial food chain largely viewed as hyper-productive and efficient; or the touchy-feely agro-ecological food web – the choice between the eco-foodie/fair traders' 100 kilometre diet; or agribusiness's belt-busting 100 kilogram diet. The "smart menu," of course, looks for the illusive middle ground – the best science while trading fairly and feeding sustainably.

I am arguing that we are in a common and continuing food crisis; that the development 'community' is at the wrong starting point; that we don't know very much; and that we have to espouse the policies and practices of the peasant organizations that, today, provide humanity with at least 70 per cent of the food we eat.

Is the food web just foodie romanticism? We tried to gather the facts that would prove the contribution of peasant provisioners (to describe both rural and urban food providers who are mostly outside the industrial food chain). But data on farm size and estimates on the number of rural peasants, for example, was at least a decade old and far from convincing. And, of course, farm calculations exclude hunting, gathering, fishing, and urban peasant production.

Is the food web just foodie romanticism?

In the end, we concluded that at least 70 per cent of the food the world actually consumes every year is provisioned by rural and urban peasants. We could also conclude that only peasants have access to the technologies and resources we will all need in order to eat in 2050.

Our 70 per cent estimate is inadvertently corroborated by the fertilizer industry⁵⁶ who worry that somewhere between 40 per cent and 60 per cent of the world's food is grown without their synthetic chemicals. This is peasant production – farmers who either don't want or can't afford industry fertilizers. But, of course, many smallholders do use fertilizer so perhaps another 10 per cent or more of the world's actual consumed foods are produced by peasants who do use chemicals.

Beyond this, a significant share of the world's food supply – conservatively, 15 per cent – comes from hunting and gathering – including artisanal inland and coastal fishers. Add to this the estimates that somewhere between 15 and 20 per cent of our food is produced in urban gardens and the suggestion that at least 70 per cent of consumed foods comes from rural and urban peasants seems modest.

Looking at the question from the other end – the industrial food chain – strengthens the case. While the quantities are enormous, according to recent FAO studies⁵⁷, at least a third of food produced is wasted either during production, transportation, processing or by rotting in the fridge. Then, calculate how much of our fishmeal and grain is fed to livestock or automobiles.

56 http://www.yara.com/doc/28899Yara_Financial_Report_2009.pdf

57 <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>

We lose food before it can rot. What's more, in OECD states (and increasingly in the global South) about a quarter of consumed calories⁵⁸ are “waisted” – consumed unnecessarily, contributing to obesity.

The unavoidable conclusion is that the industrial food chain is hugely ineffective. It only partly feeds people in the industrialized countries and has little left over for the rest of the world. The industrial food chain only gives us 30 per cent of our necessary consumption.

The table below summarizes and updates our 2009 report, “Who Will Feed Us?” available at www.etcgroup.org⁵⁹. Reference sources are available in this report and an upcoming sequel.

Chains vs. webs

Corporate food chain	Peasant food web
Number of food species and varieties in plant breeding	
150 sp. (mainly 12)	7000 sp. (Min.)
80,000 var.	2,100,000 var.
Cost of breeding new plant variety	
\$136 million (GMO)	Community activity
Number of crop wild relatives in research	
700 sp./sub sp.	50,000 - 60,000 sp./sub-sp.
Number of livestock species and breeds in animal breeding	
5 sp	40 sp.
100 breeds (approx.)	7,500 breeds (approx.)
Number of freshwater fish species harvested	
363 species (30% of human fish cons.)	22,000 sp. (70% of human fish cons.)
Kilocalories of energy to get 1 kcal of food	
4 kcal	1 kcal
Per capita/per annum kilograms of consumer food waste	
95–115 kg	6 - 11 kg
Calories per capita per day leading to overweight/obesity	
800–1,000 cal.	0 cal.
Percentage of global greenhouse gas emissions wasted	
15– 20%	Beneficial with agroecological model
Percent of global population fed	
30% (max.)	70% (min.)

*For references and additional information please go to: www.etcgroup.org

58 http://www.researchgate.net/publication/5244304_Global_burden_of_obesity_in_2005_and_projections_to_2030

59 <http://www.etcgroup.org/>

The first policy principle in any crisis is not to mess with what works. The second principle is to be led by those most affected – the peasants. They are the folks who are growing the food and have access to the diversity we will need to survive the challenges ahead. That is why the recently-reformed UN/FAO Committee on World Food Security (CFS) is becoming so important. Not only do we have all the governments and multilateral agencies around the table, civil society organizations and peasant movements are also there. The only thing peasants can't do is vote.

Peasants bring unique resources to the table and need support to deploy them. Within the first century of the colonial era – without trains or telegraphs, much less blogs or Twitter – peasants adapted Mayan maize to almost every growing region of Africa, while Asian peasants accomplished the same success with sweet potatoes. Meanwhile, Africa's enslaved peasants smuggled almost 50 crops when they were shipped to the Americas.

Africa's enslaved peasants smuggled almost 50 crops when they were shipped to the Americas.

The Columbian exchange of 500 years ago was preceded by an Arabic transfer and, before that, the Silk Road and the mud trail kept moving crops and livestock between and among Eurasia and Africa. More recently, in 1849, the US began shipping free packets of experimental seed to settlers to kickstart crop production west of the Mississippi. By 1897, more than 20 million packets of exotic experimental seed were being sent to settlers every year. The highly successful seed experiment only ended in the late 1920s when seed companies realized that public sector distribution was interfering with private sector profits.

To address climate change, we need this kind of seed exchange once again. Over the past six decades, peasants have donated at least two million locally bred plant varieties for storage in the world's major gene banks⁶⁰. Peasants are also the breeders and protectors of almost 8,000 rare livestock breeds of 40 species. Gene banks, as a policy priority, must multiply the peasant varieties and make them freely available to peasant organizations upon request.

Over the past six decades, peasants have donated at least two million locally-bred plant varieties for storage in the world's major gene banks.

If we are to survive climate change, we must adopt policies that let peasants diversify the plant and animal species and varieties/breeds that make up our menus. Plants and livestock are going to have to move around so that they can be used under the conditions in which they can thrive. There are, of course, phytosanitary considerations; support will be needed from FAO and perhaps from the Biodiversity Convention.

The only people with the know-how and patience to experiment with crops and livestock are peasants. Peasants will require a fundamental change in the regulatory machinery – including intellectual property regimes – so they can exchange and develop seeds/breeds among themselves around the world.

The rest of us urgently need to come together across all of the food web to see how we can collaborate. As cell phone technologies spread across every continent, our collective capacity to exchange information makes it possible for all of us to keep up with the innovative energies of peasants.

Pat Mooney is the co-founder and Executive Director of ETC group—an international civil society organization headquartered in Canada with offices in Ethiopia, Mexico, Philippines and USA. Since 1977, ETC group has focused on the role of new technologies on the lives and livelihoods of marginalized peoples around the world. Pat Mooney is the author or co-author of several books on the politics of biotechnology and biodiversity.

60 <http://www.fao.org/docrep/013/i1500e/i1500e03.pdf>

TOO FEW FARMERS: A VIEW FROM THE UNITED STATES

Michael O’Gorman. Founder of the Farmer Veteran Coalition

Every perceived ill of US farming boils down to too few farmers working to feed too many people. The challenge is to get more young people farming, and help them through the early years when they must focus on learning their craft.

Every perceived ill of modern farming in the United States—the overuse of harmful pesticides and fertilizers, the consolidation of farm ownership, the loss of bio-diversity, the lack of good land stewardship, the containment feeding of animals, the growing of food too far from where it is consumed and the over reliance on immigrant labor—boil down to one thing: too few farmers are working to feed too many people.

The culmination of our need to eat more healthfully, a fast-growing US population, and an aging farmer population creates a situation of tremendous opportunity and challenge in American agriculture. We need new farmers like never before and, most importantly, we need them to succeed.

Sustaining a farm financially comes down to one basic economic equation—*yield times price minus cost*. In layman terms, this equation can be understood as, how much you grow or produce on a given amount of land, multiplied by how much you are able to sell it for, minus all the costs of production.

The most difficult years for farmers are the same years that they are most lacking in experience, are most likely to make mistakes and least likely to have mastered how to raise yield and lower cost .

Currently, small and beginning farmers have at least one key element in their favor: the price of fuel. It now costs at least \$10,000 to ship a semi-truck of fresh produce to the East coast of the United States from where it has traditionally been produced in California or Arizona. That gives farmers in that region a competitive advantage of \$8 per box, on average. Add to that five extra days of freshness and the consumer’s willingness to pay more for locally grown produce, and the economic equation can justify the return of many fresh produce crops to regions of the country that had all but abandoned them.

Small and beginning farmers have at least one key element in their favour at the moment: the price of fuel.

This equation is not without its dangers. The greatest that I see is that it has many beginning farmers focus on the price side of their equation, spending more of their time and attention marketing their produce, and less on yield and cost. At the moment, new growers have the market at their back, but that can change overnight. What happens when the next big food scare isn’t from a California mega-farm but from the new young couple selling locally grown produce at a neighborhood farmer’s market?

The other danger is that this simple equation ignores many of the higher risks inherent in producing in many parts of the country. Drought in the Midwest, flooding in the South and an epidemic of late tomato and potato blight on the East Coast, all brought many young farmers that first big wake-up call—crop loss.

This equation also raises ethical questions. Many of the new farms have built support from a small segment of consumers willing and able to pay more than market value for crops grown by local farmers. And many new farms rely on college students, who though they protest the wages paid on larger conventional farms, volunteer to work for next to nothing on the farms of their friends and peers. Much of this support from consumers and volunteers is driven by the vilification of an entire food system including those—many of them hard working family farmers and immigrant laborers—that have, albeit imperfectly, been feeding us all along.

Here are some of the best approaches I see for helping beginning farmers today:

Easy access to too much money can hurt farmers in their beginning years of operation.

1. **Incubator farms**⁶¹. Incubator farms offer a combination of low-cost land, equipment access and infrastructure to help farmers launch new agricultural business. Incubators are often partnerships between non-profit groups, communities, municipalities and agricultural colleges, and are funded by government and private grants, donations and membership fees. They allow a farmer to start their business without a large capital investment and to gain experience, and make mistakes, without terminating their career.
2. **Renting land**. Land is expensive and ownership may not be the wisest investment to make. Building equity in livestock, farm equipment or a packing facility are long-term investments that can lead to growth of one's farm business.
3. **Aggregation**⁶². There are aggregator companies willing to sell farmers' products for them into a premium marketplace, allowing farmers to maintain their own brand identities. This concept allows farmers to focus on what they grow well, when it grows, and most importantly, allows them to spend more time farming.
4. **Utilizing existing markets**. While many farmers are drawn to the recognition of their work given to them through the marketplace, producing for someone with an existing market is worth consideration, such as through contract farming⁶³. This may mean a simpler production program, as well as the possibility of funding assistance, ongoing training, and the option to maintain outside employment.
5. **Micro-lending**. Beginning farmers complain about how hard it is to borrow money. Those of us who have ever farmed know that the paying back is the hardest part. Easy access to too much money can hurt farmers in their beginning years of operation. Smaller amounts of money tied to assistance with business planning and production mentoring may save farms from debt they cannot get out of.

Three suggestions for public and private investments that I would like to see—in part because they reach beyond the current demographic of today's new farmer—are:

Experienced farmers need to pass their farming knowledge on to the next generation, and we need to find ways to enable these farmers to do so.

1. **Paid apprenticeships on family farms**. The US unemployment rate is high, especially in rural areas. These rural communities are the communities where military veterans are returning home with few employment opportunities. With modest government support, a family farmer may be able to house a young veteran, or civilian and their family, and give them valuable farm training that cannot be taught in school – tractor work, fencing, mechanics, and animal husbandry. There could even be ways for creating additional income for the apprentice's family such as market garden plots or building equity in livestock. Experienced farmers need to pass their farming knowledge on to the next generation, and we need to find ways to enable these farmers to do so.
2. **Paying beginning farmers to grow for the needy**. The current model for young farmers is one of overly complex production regimens to grow highly diverse and often expensive produce for the highest-end market. There is little incentive for beginning farmers to bring vegetables to those that need it the most. A program that would buy a farmer's entire crop at predetermined prices, with choice-grade market standards and third-party food safety certification, would enable beginning farmers to grow produce for food banks, churches, veteran hospitals and other places that would not adversely affect the competitive marketplace. The farmer would reduce loss due to unsold product, save money through efficiency, and most importantly, spend his or her time learning to farm.

61 <http://www.cog.ca/uploads/TCOG%20Articles/Incubator%20farms.pdf>

62 <http://farming.ashoka.org/aggregation>

63 <http://www.fao.org/ag/ags/contract-farming/faq/en/>

3. Programs to make farmland and farm businesses available to traditional farm workers. Right now, most of the crops grown in the United States are planted, cultivated and harvested by immigrant farm labor. The movement to create more farmers is overlooking those who are the most trained and most likely to endure a career in agriculture, given the opportunity. A few great programs have reached out to this demographic, but not nearly enough.

The best new ideas are going to come from new farmers themselves. Many beginning farmers in the United States are going to be land poor, starting out on smaller and often marginalized pieces of farmland. What will make them successful will not be their marketing, but their ability to learn to be good producers. It will not be easy but those who achieve it will find not only their success but what we need to survive and thrive as a nation.

Michael O’Gorman is the founder and Executive Director of the Farmer Veteran Coalition. The coalition seeks to develop a new generation of farmers among returning veterans. He has been a pioneering organic farmer for over forty years, and for the last twenty years he has been the Production Manager for some of the largest organic vegetable companies in the USA.

DOES AGRICULTURE AS WE KNOW IT HAVE A FUTURE?

Sonali Bisht, writer, development worker and advocate

Food grown by people living in rural areas, especially smallholders, is seen as important for the future. However the consumer is king and queen in agriculture. Until aware consumers change their behaviour, the smallholder farmer will get good words, symbolic gestures, and little else. Consumers need to meet producers halfway by paying a fair price and sharing the risk.

The technology to produce synthetic food exists. Food pills are only one step beyond the vitamins, proteins and other food and nutrient supplements currently available in the market. We have knowledge of hydroponics and we can grow food in multi-storey production complexes. Certainly, there are plenty of alternatives to traditional farming for food and other needs. Does agriculture, as we know it have a future?

The technology to produce synthetic food exists.

The experts who contributed to the Future of Agriculture debate, all eminent persons, leaders in their field, chose not to address such radical alternatives, and the comments received did not dispute that choice. Clearly, food grown by people living in rural areas, especially smallholders, is seen as important for the future.

Smallholders currently constitute the majority of agricultural producers, the bulk of the poor and half the world's hungry. They are expected to continue producing for a growing and more affluent urban population, and to do so in ways that keep food prices low, preserve the environment and manage the multifaceted risks they face, including vulnerability to shocks from the natural, socio-economic and political environment. The risks and vulnerabilities faced by women and indigenous populations, and expected to be managed by them, are even greater.

The experts generally offer optimistic visions for the future of agriculture, though the reasons for their optimism vary. Experts with a background in agriculture research and industry put their faith in fossil-fuel and chemical-based agriculture to achieve the increases in productivity needed to feed the population of the future. Or they champion comparative advantage, open trade and functioning markets.

Experts with a civil society background, on the other hand, believe high production levels can be obtained without chemical- or fossil-fuel-based inputs. They cite evidence that organic and sustainable agriculture achieves equivalent production in normal years and higher in drought or abnormal years. They also see sustainable and organic agriculture as empowering for women farmers, valuing their role and knowledge in agriculture, and helping to keep them and their families out of crippling debt. And several view food sovereignty as more important than markets.

The primacy of smallholders was acknowledged by almost all the experts. Several maintained that smallholders can generate research knowledge and use it for their prosperity, noting that peasants already make an enormous contribution in that regard.

The primacy of smallholders was acknowledged by almost all the experts.

If farming is to continue, youth need to pursue it as a career. But at present, farming is not an occupation young people aspire to and smallholder farming is not perceived to be a respected occupation. Agriculture is not given the status of a skilled craft in most countries, and thus wages of unskilled labour apply. This situation can and must change in developing and developed countries alike.

Farms need to be managed as profitable businesses if they are to attract a new generation of farmers. Perhaps, as Nicko Debenham suggests, some form of community or group enterprise

would offer a sustainable business model that could generate a “more-than-acceptable living.” I wonder if that would appeal to Susan Godwin, who wants secure land tenure and more access to information for her daughter. Or to Rokeya Kabir, who says women farmers deserve more for the hard work they put in.

The views expressed were many and too rarely did those of opposing views engage each other. Pro- and anti- food sovereignty views were left unresolved. Much of the debate resided in the realm of hope, perhaps best expressed by John Ambler, who envisaged institutional reforms leading to healthier eating and a healthier food system.

The reality is that it has been difficult to build political will that favours smallholders.

The underlying challenge has always been politics. As Prem Bindrabhan observed, power structures, vested interests, economics and other drivers influence decisions in agriculture. Participants in the debate voiced this sentiment in different ways to express skepticism as well as hope. But the reality is it has been difficult to build political will that favours smallholders.

There is an Indian saying that the one who is thirsty goes to the well. The well does not come to him. Yet, without exception the experts feel farmers should produce for the market, conduct market intelligence, take their produce to the market.

One would think that if food is a priority need of consumers the initiative would come from them or their representatives. The consumer, who is generally urban and has higher income, should take responsibility for creating reserves to account for the vagaries of weather and for insurance against price fluctuations. The farmer should be in the position to decide whether he or she can produce at the price consumers offer or if further negotiations are needed. Community-supported agriculture, where communities invest in farmers by subscription, is a model that is worth more attention, as it guarantees farmers a fair price and assures consumers of clean and safe food, while sharing the risk.

The one who is thirsty goes to the well. The well does not come to him.

Mostly this does not happen. Politicians have their constituencies to please, and most of these are non-farmers living in wealthier areas of the country. Private companies view agriculture an unending stream of business and profits. The political power of the fossil-fuel industry and the lobbying clout of agribusiness keep agriculture dependent on fossil fuels.

Non-profit NGOs, though always strapped for resources, can create models of excellence which demonstrate the success of innovations. But these are rarely replicated at scale. Research institutions create knowledge which the poor are unable to access and use, while private companies can and do, often at a fraction of the real cost.

The consumer, especially the urban consumer, tends to be king in agriculture. Companies vie for a percentage of his or her essential spending and governments pander to the needs of this majority. Good intentions tend to get lost in this realpolitik. Until aware consumers change their behaviour, the smallholder farmer will get good words, symbolic gestures, and little else.

It would not cost very much to make changes that, by common consensus, would transform the future of agriculture for rural poor people. Farmers, especially women, need security of land tenure or land ownership and protection against land grabbing. Farmers require fair prices for their produce and ways of farming which do not get them into debt and food insecurity.

Farmers need to be recognized as co-creators of knowledge in agriculture, encouraged and respected for the innovations they develop.

Above all, most experts and respondents agree, farmers need to be recognized as co-creators of knowledge in agriculture, encouraged and respected for the innovations they develop. Farmers and research institutions must be linked in a web of knowledge creation and application, with joint responsibility for improving production and productivity through joint trials, participatory innovation, and farmer validation of scientists' claims. This is the key to meeting production challenges in the agriculture of the future.

National systems and multilateral agencies should support this process with NGOs and farmers' organizations facilitating accountability. Planning of production for local markets and according to local needs would avoid mismatch and waste. Application of force majeure clauses in production agreements would eliminate much of the risk. Subsidies and artificially lowered prices of commodities as social welfare measures have proven to be hotbeds of corruption and disincentives to farmers and should be avoided.

Agriculture not only feeds people, it creates engagement and employment in sustainable livelihoods, builds close-knit families and societies (especially smallholder and family farming) and supports cultural and social engagement as well as social stability. In today's world it provides an alternate way of living from the stress and strain of urban areas. It preserves our farm landscape, traditions and heritage. We all have a responsibility to preserve and enhance our agricultural heritage—and that means not allowing a single farmer or farm labourer to go hungry or to suffer for being involved in agriculture.

Agriculture not only feeds people, it, builds close-knit families and societies.

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LEVELING THE PLOWING FIELD, CREATING CHOICE

Roger Thurow, Senior Fellow for global agriculture and food policy at the Chicago Council on Global Affairs and Agriculture Fellow at ONE Campaign

The future of agriculture needs to play out on a level plowing field. 'Hungry farmers' is a ridiculous, and shameful, oxymoron. Choice will set free the future of agriculture. This requires we listen, share and cooperate.

After two weeks of lively opinion and discussion in this online debate, this much is clear: The future of agriculture needs to play out on a level plowing field. This means all farmers of the world should have equal access to the essential elements of their business – seeds and soil nutrients, financing, risk-mitigation, extension advice, markets, trade. It requires an even-handedness of government support; developing countries need to prioritize and promote agriculture and rural development as robustly as the rich and emerging nations do. And the rich world countries need to scrap trade inequities and policies that for decades have tilted the global agriculture trade in their direction and perpetuated hunger elsewhere.

The future of agriculture needs to play out on a level plowing field.

As we have learned from the diverse commentators and essayists, much of this hunger is experienced by farmers themselves, namely the smallholders of the developing world who are unable to grow enough food to avoid an annual hunger season. Hungry farmers. That is a ridiculous, and shameful, oxymoron. The future of agriculture must abolish this ugly phrase.

The goal: Creating the conditions for all farmers to contribute as much as they possibly can, not only in how much they produce but also in the nutritional quality of what they grow and what we all consume – while also preserving the environment. We're all in this together. If we didn't know it before, we certainly should have realized it in the past couple of years of climate extremes; one year there is drought in the Horn of Africa, the next year there is drought in Middle America. Be they farmers in Kenya or Kansas, their prayers were the same.

The result of a level plowing field will be that all farmers have the ability to make the choices crucial to securing and growing their livelihood. From the rich variety of comments sparked by the essays, we see that many choices exist. Indeed, these discussions are valuable in that they showcase the wide variety of choice.

A choice of seed. A choice of soil nutrition. A choice of financing. A choice of insurance and other safety net innovations. A choice of markets. A choice of prices. A choice of crops. A choice to store or sell. A choice to buy land. A choice of tradition. A choice of modern technology. A choice to stay on the farm or move to the city.

Choice. Let's not be dogmatic and stifle choice by favoring one option to the exclusion of others. Let's not sit in America and Europe and decide what the farmers in the developing world should choose. Do we know for sure that a smallholder farmer in Africa with one cow has enough organic matter sufficient for her couple of acres before we deny her the choice to use a thimbleful of fertilizer per plant – when that micro-dose might bring the hunger season to a swifter close and end the malnourishment of her children? Do we know that a farmer might need the stalks and husks of her maize to feed her cow and cook her meals and light her house before we criticize her for not leaving it all in the field to practice conservation agriculture? Do we insist that a farmer use seeds saved from the previous harvest when experience tells her that those seeds will have a lower germination rate and lesser yields than newly purchased seeds?

Hungry farmers. That is a ridiculous, and shameful, oxymoron.

A farmer may have only one season a year to make the right choices. And perhaps only 30 or 40 seasons in a lifetime. As it is today, far too many farmers – particularly the smallholder farmers of Africa – don't have any choices. For too long they have been considered too poor, too remote, too insignificant for anybody – particularly for anybody in the global agriculture industry -- to care. They don't have a choice of seeds, or farming techniques, or financing, or markets. In most cases, choices aren't affordable. In many, they aren't even available.

In most cases, choices aren't affordable. In many, they aren't even available.

These farmers live Neither/Nor lives. Their harvests are so meager that they can neither feed their families throughout the year nor pay school fees for their children. They can neither feed their families nor afford medicine. They can neither feed their families nor repair their mud-and-sticks houses to ward off the cold and keep out the rain.

At best, they live Either/Or lives. Here, they are faced with heart wrenching choices. Either feed the family or sell some of the food to send the children to school. Either feed the family or buy the malaria medication. Either feed the family or buy another cow or buy metal sheets for the roof or buy more land to diversify the crops. They can't do both. They can do one or the other. These decisions – how they are made, how they impact the families – drive the narrative in my new book, *The Last Hunger Season*.

What I learned in my reporting is the farmers' great desire to live AND lives. Lives where they can produce a surplus harvest of nutritionally improved food so they can feed their families throughout the year AND pay the school fees for their children – AND afford the malaria medication AND diversify their crops AND improve their houses AND buy another cow or more chickens AND buy more land.

Choice. Creating choice – delivering choice – should be the aim of development, especially agricultural development. Choice is freedom. Choice is liberating. Choice is empowering, particularly for women in the developing world who would be making many of these farming decisions. Choice is encouraging, especially for the youth and especially if they can see that farming isn't only for merely surviving but that it can be the way to robustly thriving. Choice will set free the future of agriculture.

If the farmers desire to live in an AND world, so should we all. We can't insist on Either/Or development. As a number of commentators have noted, no one size fits all. There really are no silver bullets. We need both small ag and big ag. Ethiopia, for example, needs both the wheat and maize farmers in the highlands cultivating thousands of acres AND the smallholders tending only an acre or two. We need old traditions of saving seed when that seed is still productive AND new seeds to trump disease, pests and climate change. Some farmers can go all organic and thrive, some need fertilizer to escape the hunger season and survive. We need traditional AND modern techniques. We need local knowledge AND international innovation. It's not a matter of soil versus seeds, but soil AND seeds. It's increasing production AND increasing quality. It's agriculture AND nutrition. It's intensification AND conservation.

Silos for food storage are wonderful for promoting choice: sell now or hold for later? But silos in the other definition of the word – narrow, blinkered, selfish thinking – obscure choice.

Choice will set free the future of agriculture.

Providing choice requires infrastructure development; infrastructure to provide access to inputs, to transport surpluses to shortage areas, to support efficient markets, to provide knowledge. It requires policy frameworks that encourage innovation and transparency and accountability. Above it, it requires that we listen and share and cooperate. These things can level the plowing field and create an equality of choice.

On one matter, though, there really is no choice: We need all farmers, everywhere, to be contributing as much as they can if we are to meet the great global challenge of nutritiously feeding nearly 10 billion people by 2050. We especially need the world's smallholder farmers. Neglected for so long, they are now indispensable to the future of agriculture and food.

Roger Thurow is the Senior Fellow for global agriculture and food policy at The Chicago Council on Global Affairs and Agriculture Fellow at ONE Campaign. He was a reporter for *The Wall Street Journal* for thirty years. As a foreign correspondent, he reported from more than sixty countries, including two dozen in Africa. He is the author of *The Last Hunger Season: A Year in an African Farm Community on the Brink of Change* and *ENOUGH: Why the World's Poorest Starve in an Age of Plenty*.

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