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Food and Agriculture: the future of sustainability

Summary of Key Points

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Executive Summary

Our population trajectory means that from now to 2030, the world will need to build the equivalent of a city of one million people in developing countries, every five days! There is widespread consensus that, going forward, farmers must produce more food per unit of land, water, and agrochemicals. To do so, however, they simply cannot continue producing in the same way. They will have to do this while facing climate change, volatility, shifting nutrition needs, and the increasing scarcity of most of the physical factors of production. Agriculture is at the threshold of a necessary paradigm shift.

This paper illustrates how leading thinkers imagine our future food and agriculture world. It eschews positions and instead invites reasoned discussion. It cuts across the thought silos intrinsic to different world views and partisan values to identify consensus and also disagreement. We solicited input from leading experts in different dimensions of agriculture, representing the perspectives of the natural and social sciences, developing and developed countries, policy and academia, public and private. Respondents were asked about most significant trends and the most important priorities in the next 20 years to ensure sustainable food and agriculture systems.

Farming has enormous impacts on the world's most critical resources. Accordingly, farmers will have to produce while also ensuring the provision of various vital ecosystem services. If they do not, we will not only degrade those resources but also exhaust the ability to produce enough food.

These expectations pose quite a challenge and the overall outcome depends very much on the response of millions of mostly small and medium farmers. The current 'more production' orientation is so outdated and unresponsive to our current needs that it is causing its own problems, particularly for our environment and natural resources. Although food is critical, it is not just about food. We have a pressing need for new approaches in policies and structures that realistically account for the formidable environmental impacts and consider the social consequences of our evolving agri-food systems. Rather than simply "more" production, we must also consider what would be "better" production and better food systems.

There are many who advocate a profound re-thinking of our current models and, to better serve our coming needs, would re-imagine and transform the world's major agriculture and food systems, not just tinker at the margins or modify them incrementally. Recent decades have seen such re-imagining result in radical and world-changing innovations in every field from politics (social network media) to healthcare (nanotech-based diagnostics and drugs) and communication (mobile telephony).

**For the first time at a global level,
food production faces multiple limiting factors
for key resources such as land, water, energy and inputs.
We must use this challenge to stimulate creative innovation**

Main Trends and Challenges

There are opportunities and also considerable challenges and some are new. For example:

- We now face astonishing levels of **waste**, 30-40 percent of all food, and at every step of the food cycle. Every year, high percentages of the food produced in developing countries never makes it to market and consumers in rich countries waste as much food as the entire net food production of sub-Saharan Africa.
- We are aiming at the wrong goal. For the first time in history we have as many overweight people as undernourished people and the consequences of our emerging dietary habits are on a disastrous trajectory for human health and for ecosystem health. Yet, agriculture policy concentrates mostly on production and trade and is curiously divorced from the vital issues of good nutrition. We need to actively shift our focus to two areas:
 - a) more **access** since we already have more than 4000 kcal per person per day in traded foods; and
 - b) more **nutrition** or healthy food because the explosion of empty calories in many developing countries reflects the meteoric rise of the clinically overweight in many industrial economies.
- The current trends in **livestock** and **biofuels** are likely to lead to more crises in the near future as they inefficiently use food-related resources.
- Pressures on **food prices** are exacerbated by volatile market dynamics, inadequate global coordination and the multiple effects of population growth, energy markets, climate change, land degradation and water scarcity.
- **Concentration** in supply puts us at increasing risk. With more than 50,000 edible plants in the world still, nearly two-thirds of our food comes from only 3.
- **Governance** is shifting. The main actors are not heading in quite the same direction. Agriculture discussions are increasingly oriented toward ecological approaches that recognize the limits imposed by natural resources and toward improved social outcomes. However, many international agencies, multilateral and bilateral institutions are barely beginning to promote such concepts in agriculture; whereas some food companies and NGOs are taking the lead instead. Corporate power has grown to easily rival the influence and effect of the state, changing the dynamics of local and global food systems. Consequently, we will not advance effectively unless we address how public policy and private sector investment choices integrate toward a common good.
- Agriculture is one of the biggest threats to a healthy environment. It uses most of our available fresh water and some 20,000–50,000 km² of potentially productive lands are lost annually through soil erosion and degradation, much of it in developing countries. Besides its production function, agriculture needs to integrate other **vital functions of ecosystem management** as central features of its development

Where will solutions come from? As many governments have retreated from agricultural investment there is a shifting re-organization of roles and governance from public to private. Clearly, private enterprise is a powerful factor, and even more so with increased concentration all along the supply chain. Firms themselves also face new governance challenges with volatility in supplies and markets and increasingly transparent conditions. Forward-looking firms recognize the need to create shared value and not just profit if they are to thrive. How can public governance work with companies to foster both public and private benefits? How can we now employ vastly improved methods for understanding the impacts we are creating and use these to evolve new learning pathways for producers, firms, and policymakers? The public sector must offer a more

thoughtful and principled guidance that takes into account longer-term public needs and the private sector will have to be a major part of the solutions to the new challenges of our food and agriculture systems.

In light of the state of agriculture, there is agreement in a number of important areas even across the distinctive world views embodied in the four diverse groups that undertook this process: Policy and Trade; Business Specialists; Rural Livelihoods and Poverty; and Environmental Sustainability. Being explicit about both the differences and the areas of consensus enables us to focus on realistic efforts right now.

Nine key areas of consensus have emerged as the key paths of action:

1. Organized small and medium farmers, fully including women farmers, should be a primary focus of investment – recognizing that private enterprise will play a significant role in many solutions
2. Define the goal in terms of human nutrition rather than simply “more production”
3. Pursue high yields within a healthy ecology – they are not mutually exclusive and policy and research must reflect that
4. Impel innovation and the availability of diverse technologies suitable in different socioeconomic and ecological contexts
5. Significantly reduce waste along the entire food chain
6. Avoid diverting food crops and productive land for biofuels, but explore decentralized biofuel systems to promote energy and livelihood security that also diversify and restore rural landscapes
7. Insist on intelligent and transparent measurement of results - we cannot manage what we cannot measure
8. Develop and adapt public and private institutions that can effectively respond to these new goals
9. Motivate and reward investments and business systems that result in measurable impacts to the “public good”

Key Details

**Agriculture must move
from being managed as an extractive industry
to one that is more renewable**

Who

1. Organized small and medium farmers, fully including women farmers, should be a primary focus of investment.

Both food security and environmental benefits, especially in developing countries, will continue to depend upon increased and more secure production among small and medium farmers. And they have proven that they can do it. In parts of peri-urban China the yields of food crops on small parcels of land (less than one hectare) provide not only diversified subsistence for the household but also substantial supplies of marketable produce as well – all without excessive agrochemical use.ⁱ Even where markets are lacking in urban areas, such as Havana and Dar es Salaam, for example, a substantial percentage of the cities' total fresh food comes from very small intensively farmed urban plots within both cities.ⁱⁱ So, farm scale itself is less the problem than the ability to cooperate and get access to necessary resources such as knowledge, financing, markets, and inputs.

Yet, farmers cannot always be viable and agriculture-related employment in areas such as inputs, post-harvest, and processing will also be a valuable component of rural advancement and value creation.

- **Farmer organizations and extension services are indispensable.** These require consistent public policy and friendly institutional support in order to thrive. Extension must also be co-managed and evaluated by producers and adequately incentivized so as to tailor public-private models of extension for both their effectiveness and their overall sustainability impact.
- **Women play a very important role in agricultural production and especially in household food security; agricultural programs and policies that address women as part of a dynamic solution can empower rather than marginalize them.** There is clear consensus among the contributors to this paper and between leading development and agriculture organizations, including IFAD, FAO, WFP, the World Bank, and the United Nations Committee on World Food Security that gender equality is a core premise and a central pillar of development.ⁱⁱⁱ Land tenure is particularly important so that they can farm with surety and invest in their farms and soils. They will also need more training, information, and credit.^{iv}
- **Private enterprise will play a major role in many solutions.** Companies have enormous impacts that can be positive or negative. Few policy tools are as effective as market and price signals to value and foster the key public goods and societal values that can be generated by agricultural landscapes. Companies have enormous impacts, so it will be vital to learn how to appropriately manage and incentivize firms to ensure that their activities result in public benefits even if these may sometimes be intrinsically less profitable in the short term.

What

2. Define the goal in terms of human nutrition rather than simply “more production

Agriculture policy and investment will be smarter to focus on improved human health and access to nutrition, and not only on increasing food supply. We are simultaneously faced with record numbers of malnourished people and an explosion of obesity and diet-related diseases. Since food crises and malnourishment occur even in countries that have adequate production and are net exporters, access to nutrition is a vital issue. Yet, the consistent failure of structural mechanisms to shift food from abundant sources to areas of need reflects both persistent market imperfections and policy failures.

If Warren Buffet is correct that markets are inefficient and imperfect then it makes sense not to completely rely on them for all the solutions to this complex problem. If food security is also perceived as a national security issue, then it is smart to have balanced policies that – while continuing to refine and improve the trade regimes and market delivery systems – also stimulate more localized resiliency and self-provision of at least some foods rather than having marginal groups rely solely on purchasing and markets.^v If done with care for environmental and social concerns, localized systems can also offer an opportunity to improve local well-being by fostering greater crop and nutrition diversity.

- **Subsidies for foods that do not contribute to public health must be eliminated. Public funding should support not only research for low-cost, high-nutrition options but also the systems of access to sound nutrition (e.g. via schools and local markets).** The current food system’s valuable technical breakthroughs in increased shelf-life and variety are increasingly overshadowed by the issue of nutrition quality since some foods are associated with a variety of ailments including heart disease, some cancers, diabetes, and obesity. .

It is foolish to depend completely on local foods or completely on trade, both are valuable for food security

3. Pursue high yields within a healthy ecology – they are not mutually exclusive and policy and research must reflect that

Agriculture will become a central feature in the management of healthy ecosystems and multifunctionality will become a key consideration as we evolve beyond just ‘yield per hectare’ to broader working definitions of ‘productivity’ in agricultural landscapes that encompass valued ecosystem services such as water infiltration, carbon sequestration, and conservation of biodiversity.

- **Invest in water-conscious agricultural systems and restore healthy soils.** Few natural resources are as consequential and as immediately endangered as water, so the adoption of conservation tillage, modern genetics (not necessarily GMOs) and mechanical or drip irrigation can further increase the amount of ‘crop per drop’. The health of soils is interlinked with water

management. Policies that support the concept of multifunctional agriculture can contribute to both soil and water quality at the landscape level and remedy contamination with improved management of erosion and of nutrient or biocide applications. Water's role in agriculture is pivotal, particularly to generate the necessary increases in productivity. There is complete agreement that many fresh water sources are in decline and agriculture is increasingly competing for water resources while water quality is also deteriorating in many parts of the world.

- **To conserve our remaining natural habitats and biodiversity, the best option is to rehabilitate agricultural and pastoral areas that have been eroded and degraded**, rather than converting new lands since most suitable new land is a repository for important biodiversity or otherwise fragile.
- **Climate-smart production systems will be vital for necessary adaptation.** Agriculture both contributes to climate change (GHG emissions mostly via livestock, deforestation, and fertilizers) and is also in turn affected by the shifts in climate. Impacted areas will need to rely on food from healthy regional and international markets. At the same time, food production must adapt and become more resilient. Even where agricultural conditions could benefit from climate change (i.e., more rain in semi-arid areas or higher temperatures in cold regions) the near-term benefits are still likely to be very limited as farmers adapt to new conditions, soils, and cultivation methods. This will require considerable investment in more adaptable crop varieties and expanding farmer training in appropriate methods. Considerable opportunities exist for improving indigenous crops, many of which are already adapted to harsh environments and resistant to disease.
- **We need to aggressively invest in a combination of market mechanisms and policies that advance agriculture while scaling-up the approaches that improve its delivery of ecosystem services.** This is critical since public goods such as biodiversity, genetic resources and even traditional knowledge are predominantly subject to private use and are not adequately assessed for their real value; this reduces the scope for the broad cross-border cooperation necessary to safeguard such resources and use them in non-depleting ways.

**New demand patterns have to be addressed
if we are to meet expanding food needs.**

These include: population growth rates; increased consumption of livestock products; and arable land used for biofuels.

How

4. Impel innovation and the availability of diverse low technologies and high technologies suitable in different socioeconomic and ecological contexts

- **Technology matters most if it is affordable and if it is appropriate to scale and conditions.** Developing countries are littered with decades of failed projects that do not take that into account. Technologies need to become increasingly democratized and more widely available in low-cost forms to small and medium producers. From the re-discovery and re-

application of integrated indigenous systems to new scientific breakthroughs we already have many useful tools and technological resources that need to be made more available to small and medium farmers. These include:

- improved breeding for new traits
- climate-resilient agricultural systems, such as precision farming and remote field sensing that more efficiently utilize irrigation and inputs, sequester carbon and reduce GHG emissions.
- improvement of minor or neglected crops
- perennializing grains
- mobile phone-based systems and other information technologies for price information, plant analysis, and digital transactions

Technology can facilitate the sort of swift adaptability that will be increasingly necessary as climate change and other pressures mount. Information and communications technology is enabling innovation to both reach users in all but the most remote areas with information and methods and also emerge from them in the form of novel practices. Creating more local capacity to access and use very low-cost information systems is an area of broad consensus. Globally-integrated monitoring systems can now produce timely public information with forecasts of food sufficiency in every country around the globe.^{vi}

Technology is not solely based on complex machines and sophisticated science, we must include production or resource management systems whose native ingeniousness is in the simple ways of doing things that work well. There are many local-level and worthwhile innovations that are pro-poor and enable local food security but they are not attracting attention or investment. Some, like *zai* pits, developed to store water for trees or crops in dryland regions or the use of companion planting (i.e. leguminous trees and ground cover) have spread widely among farmers in many countries and with many crops. But many languish because they are not as obvious or may not be inherently lucrative as a business model or may apply only to a limited region. Yet these innovations, if systemically captured and valued, could lead to considerable cross-learning and low-cost sharing.

Simplicity may be why governments and development agencies overlook such efforts in favor of more sophisticated technologies. Simple cost-benefit analysis coupled with a practical understanding of how technology spreads can facilitate thousands of such simple innovations. Indeed, without such simple technological precursors, it is considerably riskier to introduce more sophisticated technology. **The global interest in identifying, stimulating, and transferring practical innovation needs to manifest in visible incentives and investment to encourage systemic innovation and reward breakthroughs across the entire food system and especially at the local level.**

Rather than operate with a false dichotomy between high yields and healthy ecology, we must evolve technology complementarity to play multiple roles of improving both inputs and natural resource management in the same system.^{vii} To do this requires moving away from the outdated pipeline model of innovation toward models that create inclusive learning alliances that engage farmers, private firms, and civil society organizations alongside researchers and policymakers.

Technologies will become increasingly democratized
and more widely available in low-cost forms.
They can be game-changers.

5. Significantly reduce wastes along the entire food chain

- **Waste will be a top focus** since it is most responsive to investment and policy. Reducing waste can, relatively effortlessly, add a considerable percentage to our food supply and have positive environmental consequences.

6. Pursue biofuel production to help achieve energy security and livelihood security, but without diverting arable land and food sources

- **Biofuels have potential to provide some energy security and even contribute to rural livelihoods but they are counter-productive when they divert arable land and food sources.** Using sound metrics to understand the outcomes will likely suggest that any support or subsidy only apply to biofuels that do not negatively impact the food economy.

7. Insist on intelligent and transparent measurement of results - we cannot manage what we cannot measure

- **In an era of “big data”, agriculture is tera-miles behind. We must use our new technical impact measurement ability to drive performance-based investment and more informed policy.** ¹ Improved science-based metrics are emerging to define common and comparable indicators of sustainability based on empirical data. Advances in several fields now enable more comprehensive understanding of what works and what does not. So, for the first time, we can assess not only simple economic or financial outcomes but the accompanying social and environmental ones as well.² If we can thus better manage our outcomes we can better devise learning pathways and guide smart investments and policy toward those approaches that provide effective multi-dimensional solutions while elucidating the relative efficiency or distortionary effects of tools such as subsidies, green incentives, and environmental taxes.

Critical Conditions

8. Develop and adapt public and private institutions that can effectively respond to these new goals

¹ New technology and methods permit new insights and advantages. For example: McKinsey Global Institute (“Big data: The next frontier for innovation, competition, and productivity”) notes that “Improved data handling ability opens up many new opportunities and may be “a key factor in how nations, not just companies, compete and prosper”. (Brown, Brad, Michael Chui, and James Manyika. 2011 Are you ready for the era of ‘big data’? *McKinsey Quarterly*)

² We are beginning to understand the impact that different agricultural approaches have on sustainability. Scientific efforts include: UNDP’s Multidimensional Poverty Index, Ecological Footprint, Keystone Field to Market, Yale University/CIESIN Environmental Sustainability Index, and the Committee on Sustainability Assessment (COSA).

- **Our institutions, particularly but not only government, must have a purposeful vision to invest in community well-being and to secure and restore natural resources in and around farming landscapes—especially water, grasslands and forests—in ways that also increase agricultural productivity and enhance resilience to climate change.** The right policies will mobilize government, civil society and private finance investment in this vision of agriculture.
- A policy and incentive framework that addresses the main externalities of agriculture must increasingly emerge based on recent advances in our understanding and our ability to measure and realistically value both societal costs (e.g. carbon emissions, ecosystem degradation, and groundwater depletion) and societal benefits (e.g. crop genetic diversity, carbon sequestration, water purification, and nutritional value of foods). A combination of clear policy and price signals that reveal the relative costs and benefits to society of different forms of agriculture are perhaps the most comprehensive and efficient way to achieve systemic shifts toward sustainable agriculture and food systems.
- **Promoting market-based innovations must be on the agenda of more effective public institutions.** For example, can the public sector effectively support private participation in better soil management and watershed protection? Can the public sector advance the capacity and fair governance processes necessary to facilitate smallholder participation in value chains? Or can we create the strong policy and incentives to reduce the considerable waste and better distribute the food we already produce?
- Government has decreased relative investment in agriculture in recent decades. The result was expected to be increased private sector investment and even efficiencies in some areas. However, it is now clear that private enterprise will not fill all the gaps adequately. Thoughtful government investment — preferably complementing the comparative advantages of private investment — is absolutely necessary if we are to improve the handling of the issues that most affect the poor such as: food security; wide availability of inputs; extension and knowledge services; local market and storage systems; and land tenure.

9. Motivate good business and reward investments and business systems that result in measurable impacts to the “public good”

- **New institutions and their emerging standards are collaborating with business, and producers, to accelerate our shift toward sustainability.** In an ever sharper competitive landscape and amidst unprecedented levels of transparency, smart firms are recognizing the limitations of various resources they depend on, from crops to goodwill. Commercial standards are evolving in dramatic ways from serving merely as vital trade lubricants toward providing a means to accelerate the evolution and transparency of markets to provide greater public benefits. Food safety is an important result of good standards and is best achieved as a combined public and private investment with clear governance and oversight functions that are adequately funded by mandate. Voluntary standards, including those involved in carbon markets, social accounting, organic, and other environmental standards are among the new market mechanisms that connect profits with the provision of public benefits. Can voluntary standards bodies serve as civil governance institutions and enable sustainability in agriculture? There is certainly increasing partnership between these standards bodies, governments and official development agencies. Corporations are also partnering with them at an unprecedented pace.

Several of the world's most successful food companies including Kraft, Mars, Unilever, and Starbucks have made public commitments to buy substantial portions of their raw materials from "sustainable" sources that are third-party certified by voluntary standards bodies.

- At the ground level, **few investments or policies would provide more incentive for improved agricultural practices than to increase access of small and medium enterprises, including farmers, to reasonable credit that is targeted to diversified and resilient ecoagriculture systems.** Although the category of impact investing targeting sustainability is still a modest portion of overall global investment, it will direct almost USD 4 billion toward specific impact objectives in 2012 and is an economically effective way to complement government and philanthropic spending to support agricultural sustainability at scale.^{viii}

Areas of Disagreement

Despite the considerable consensus described above, there remain some areas of significant disagreement. Some of these are due to differing worldviews or values. But many disagreements could be amenable to moderation or even solution through better dialogue or addressed through analysis and science. We still face challenges to consensus in these areas:

- Will large or small scale farming best deliver food security?
- What roles should corporation have in our food systems?
- What role could GMOs play in improving food security?
- How much agrobiodiversity should we promote in our farming systems?
- What agricultural production technologies will best deliver sustainable food security?
- Can we adapt to growing demand for livestock products?
- How can trade affect food security?

Conclusion

To handle growing food demand, it is clear that "business as usual" is not a viable option. Investing in more of the same is unlikely to give us better or different results. We have taken some steps toward sustainability but we have not fundamentally altered the way we measure, understand, and incentivize our agricultural systems. We are a bit stuck in a dated paradigm and we need a broader vision and bolder ideas that help nourish both people and the planet.

This is not a minority view. The ideas put forward here are widely shared by the world's leading scientists and thinkers on agricultural development.^{ix} There is, quite simply, no question about the need to alter and update the way we manage the intrinsically intertwined food and environmental systems on which we depend.

The political and financial landscape has recently lurched from crisis to crisis. Waiting for a crisis to happen in agriculture is a very dangerous strategy for change. Amidst increasing populations, will we wait to take meaningful action as the stakes escalate? New options and many areas of common agreement are available now to begin a shift and to create a more sustainable food and agriculture system. We can build on that and there is much that can be done. We need only begin.

Acknowledgements

Four broad-based groups participated in this high-level effort to solicit views of thought leaders with typically diverse world views facets of agriculture on how the food and agricultural system could become significantly more sustainable while best meeting the need for global food security. These included:

- Group 1: Policy and Trade Group convened by Charlotte Hebebrand of the International Food & Agricultural Trade Policy Council (IPC).
- Group 2: This Business Specialists Group was convened by The Keystone Center and coordinated by Sarah Stokes Alexander, Julie Shapiro and Keith A. Wheeler.
- Group 3: The Rural Livelihoods and Poverty Expert Group was coordinated by Danielle Nierenberg of Worldwatch Institute's Nourishing the Planet project.
- Group 4: An Agricultural Production and Environmental Sustainability Group convened by Sara Scherr and Jeffrey Milder of EcoAgriculture Partners.

Many dozens of experts from two dozen countries offered their views for the paper. The overall paper is an independent synthesis of many views wherein important consensus points have emerged. Of course, the views represented in synthesis do not necessarily reflect the contributors' specific views or have the specific endorsement of the entities they represent.

ⁱ Giovannucci, Daniele. 2005. Organic Agriculture and Poverty Reduction in Asia. Thematic Evaluation Report No. 1664. IFAD: Rome

ⁱⁱ Whitfield, John. 2009. Seeds of an Edible City Architecture. *Nature*, Vol 459, pp. 914-915.

Premat, Adriana. State Power, Private Plots and the Greening of Havana's Urban Agriculture Movement. *City & Society*, Vol 21, Issue 1, pages 28–57, June 2009

ⁱⁱⁱ Recent reports include: the 2011 FAO's "State of Food and Agriculture" that addresses "women in agriculture: closing the gender gap for development" and World Bank. 2011. World Development Report 2012 on Gender Equality and Development. The World Bank: Washington DC

Despite mounting evidence of the essential role played by women in agriculture and food security, they continue to be neglected in investment and programs by their own governments and by many donors as well.

^{iv} Some aspects such as the need to make land rights, finance, training, and technology available to women farmers have been studied but less is known about the best ways to do that or to help women create access and opportunity.

^v Headey, Derek and Shenggen Fan. 2010. Reflections on the global food crisis: how did it happen? how has it hurt? and how can we prevent the next one? International Food Policy Research Institute: Washington, D.C.

^{vi} See existing systems e.g. Communication Education and Public Awareness (CEPA)

^{vii} While contributors had diverse perspectives regarding the role of GMOs, as noted later in this section, they agreed on many other aspects of technology.

^{viii} Saltuk, Yasemin, Amit Bouri, Giselle Leung 2011. Insight into the Impact Investment Market. J.P. Morgan and the Global Impact Investing Network: New York

^{ix} Details vary, but a review of the recent major agriculture reports from the World Bank, the UK's Foresight Programme, IFPRI, Agrimonde, the International Assessment of Agricultural Knowledge, Science and Technology for Development and others concur on the identification of similar challenges and some of the solutions