Sustaining Food Security in the Developing World: An Agenda for Science and Technology

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Introduction

The food security challenge that the development community has been grappling with over the last 50 years or so has become increasingly complex over time. In the 1940s and 1950s the challenge of improving global food security seemed a daunting, yet relatively straightforward task of increasing food production and increasing access to food predominantly for rural societies.

Over the last half a century the world has changed dramatically and so has the food security challenge. Urbanization and globalization are becoming pervasive, private sector involvement in agricultural research has been increasing at a very rapid pace around the world, and global concerns about the sustainable management of resources have been rising. The global food security challenge has over time become increasingly complex as well as more multi-dimensional.

This paper presents what I see as the primary challenges for global food security, over the next 20 to 25 year time period, and the role of science and technology in meeting those challenges. The challenges are: i) provisioning the urban masses especially the urban poor with adequate amounts of food and nutrition; ii) eliminating rural poverty and attacking the problem of chronic food insecurity; iii) repositioning developing country agriculture in the context of globalization; and iv) sustainably managing the natural resource base.

Provisioning the Urban Masses

Over the past 50 years the world has changed dramatically from one that was predominantly a rural based world to one where almost half the population is living in urban areas. Today approximately 3 billion people live in urban areas. The UN projections show that by the year 2030 5 billion people will be living in urban areas as opposed to roughly 3 billion in rural areas (UN 2000).

Providing food to these exploding urban populations will pose a dual challenge. First, the size of the middleclass populations is increasing very rapidly in urban areas, both in absolute as well as relative terms. As middleclass incomes grow, this community starts moving away from a traditional cereal-based diet to a diversified daily diet that demands, meat, milk, fish, vegetables, fruit, etc. Supplying the needs of the diversified diet of the growing urban middle class populations is a major emerging food policy challenge facing developing country policy makers.

At the same time the locus of poverty is changing dramatically over time and is going to change even more over the next 20 years. We find that the very poor, the poorest of the poor, are moving into urban areas, expanding the urban slum populations in cities like Bombay, Bangkok, Manila and Mexico City. Populations living under a dollar a day are increasing dramatically in the mega-cities around the developing world. How do we provide for the food security of these very poor urban populations?

Considerations of provisioning future urban conglomerates would necessarily require us to seek an appropriate balance between trade and domestic production. Since 18 out of the 23 mega-cities projected for 2015 in the developing world are located on the coast, it may be

cheaper to import a large proportion of their food requirements by sea rather than bringing it by land from the hinterlands. Even so, the need to re-orienting domestic production towards growing urban demands will be a major force driving change in rural environments across the developing world. It is also important for us to remember that urban demand for resources, such as land, labor , and water, will significantly effect access and relative prices of these resources for rural producers.

What is the science and technology agenda for provisioning the urban masses?

Much of the food policy discussion and policy making in the developing world is centered on increasing cereal crop productivity in predominantly subsistence production systems. Urbanization and the associated diet diversification induce increased commercialization and diversification of agricultural production. Identification of technologies and policies that allow for the least cost transition to a diversified agricultural system would be crucial. The demands on the research system shift from an emphasis on quantity to product quality (both in nutritional and safety aspects). Post-harvest processing, agro-industrialization, and food chain issues dominate production issues in terms of priorities. The rapid absorption of resources out of the rural sector places a great demand on the agricultural research and development sector to generate technologies that are less demanding of the primary factors of production, particularly land, labor, and water. At the same time, quality and safety considerations require the agricultural science community to generate and promote technologies that significantly reduce the dependence of the farming sector on chemical inputs, particularly fertilizers and pesticides.

Persistence of rural poverty and food insecurity

The second area of urgent concern is the persistence of poverty, especially rural poverty, and growing food insecurity. The numbers are very clear on the magnitude of the problem: about 1.2 billion people live on less than a dollar a day, 2.8 billion live on less that 2 dollars a day. 44% of the world's poorest of the poor (those under a dollar a day) live in Sub-Saharan Africa and 40% live in South Asia. Tremendous progress was made in reducing poverty in East Asia, Southeast Asia and in Latin America over the last three decades, but the recent financial crisis in East Asia and Latin America and the recent slow down in economies could lead to a reversal of those trends. There are no clear numbers on the rural to urban distribution of the poorest of the poor, but they are believed to be proportionately greater in rural areas and in very marginal production environments. Better economic policies with appropriate social safety nets would certainly reduce the number of poor, in absolute and proportionate terms, but there would still be hundreds of millions of people who are left behind.

Who are the people left behind? They are people with very poor endowments of physical and human capital. They are often people who belong to female-headed households, who generally live in a very unfavorable production environment and who have very few marketable products, and for whom the transactions costs of reaching the markets are very high for them.

High levels of investments in education and infrastructure improvements targeted towards marginalized people will go a long way to integrate them into the market. The second would be reducing transactions costs in accessing markets for these households, transactions costs in accessing output markets but also input markets and transactions costs involved in acquiring information on technologies, on markets, and on institutions that can help them improve their lives and livelihoods. The third area of targeted policy interventions for marginalized people is to assess the role of research and technology development specifically for the less favorable environments.

What is the science and technology agenda for the people that are left behind?

Significant progress has been made in the development of drought tolerant crops, high temperature tolerant crops, etc, but a lot more can be done in improving the productivity of agriculture in the marginal environments and in disseminating that information to the people who need it the most. Similar attention ought to be paid to assessing the technical feasibility and economic viability of nutrient enhanced grain, with particular emphasis on Vitamin A rice, and Quality Protein Maize (QPM). Advances in biotechnology can play an important complementary role by strengthening the breeder's toolkit and extending the reach of conventional methods. At the same time, increased understanding and acceptance of research tools that draw on farmers' participation could help target research outputs to particular environmental and socioeconomic niches. The over riding challenge for the marginal environments is in developing and promoting technologies that are both productivity enhancing while at the same time resource conserving. A final point for this agenda item is that even as we discuss the potential for biotechnology for addressing the problems of the poor, we ought to recognize the fact that poor and marginal farmers have not yet been successful in accessing the technology that is already on the shelf today. Identifying small farmer constraints to technology adoption and use continues to be an issue that the development community ought to deal with.

Repositioning developing country agriculture in the context of globalization

Integration of developing country economies into the global system, especially for agriculture, leads to changing terms of trade and competitiveness of domestic food grain production. This happens as global food price signals start getting transmitted into developing countries markets as they open up; given that global food prices are low and are expected to continue to decline, domestic competitiveness of cereal crop production will decline.

Economic liberalization and urbanization also lead to the rise in rural labor costs as labor moves out of the agriculture sector. Rising labor and input costs and falling output prices lead to declining terms of trade of domestic food crop production relative to imports. As food crop terms of trade change producers tend to look for areas of competitive advantage for allocating their resources and for increasing their income through farm production.

Within a particular country the adjustment cost to a more globalized system are going to be the highest for people who are displaced from the less competitive sectors and those people who are left out of the market. Lack of physical and human capital, as well as institutional constraints prevent the very poor from making a smooth transition to a globalized world. Across countries the least developed countries would have very significant adjustment costs in the move towards a globalized society.

What is the science and technology agenda for developing countries facing a global food market?

An area in which science and technology can play a crucial role is through enhancing competitiveness through technological change, particularly for food crops. One can look at ways in which unit production costs of cereal production can be reduced dramatically. In order for the cost per ton of output to drop faster than the price the farmers face we need to see a sharp increase in output per unit of input, either through a shift in the yield frontier or through improved input use efficiencies. Reducing transactions costs associated with market access could also help enhance the competitiveness of small farmers.

Globalization, on the other hand, has dramatically increased the transactions costs associated with technology access by developing countries due to the growing importance of proprietary biotechnology investments in agricultural research. Private sector investments in genomics

and genetic engineering could be potentially very useful for addressing the problems faced by poor farmers, particularly those in the marginal environments. The question that needs to be asked is whether incentives exist, or can be created, for public/private sector partnerships that allow the public sector to use and adapt technologies developed by the private sector for the problems faced by the poor. Can licensing agreements be designed that will allow private sector technologies to be licensed to the public sector for use on problems of the poor?

Managing the natural resource base

There are numerous concerns about the management and degradation of natural resources. Here I will deal only with four specific areas of concern: i) degradation of intensively cultivated lands; ii) exploitation and erosion of marginal lands; iii) water resource depletion; and iv) depletion of genetic diversity.

The intensively cultivated irrigated lowlands of Asia were the lands that were home to the green revolution. Productivity growth on the irrigated lowlands, that are under double or triple crops of rice per year, or under rice followed by wheat each year, was the primary reason for Asia achieving food self-sufficiency in the late 1970s and early 1980s. Over the last decade these areas have begun to exhibit signs of productivity decline due to very poor management of the water and the land resource base due to inappropriate intensification.

Second, one sees as populations grow, particularly in countries with stagnant or slow growing economies, agriculture production starts taking over very fragile landscapes. Without appropriate property rights and adequate investments in land management, intensification of marginal lands leads to high levels of erosion over time. The third area of concern is water resource depletion and degradation. Problems of groundwater depletion, salinization and other water quality problems are becoming widespread across the developing world, especially in areas with severe inter-sectoral competition. Finally, agricultural modernization is leading to the erosion of local genetic resources across the developing world. Traditional cultivars that were uniquely suited to particular agro-ecological niches, especially in marginal environments, are being replaced by modern varieties that can be cultivated across several production environments.

What is the research and policy agenda for the sustainable management of the natural resource base?

The first item on the agenda for sustainable resource management is to create better incentives for judicious resource use. Input and output price policies as well as improved property rights are essential for the long-term sustainability of resource use. Price policy reforms would require adjustments in both macroeconomic as well as agriculture sector specific policies. In considering reforms in price signals we ought to pay particular attention to potential trade-offs between food security goals relative to resource conservation.

The second item on the agenda is to target research and development specifically towards technologies that are both productivity enhancing while at the same time resource conserving. Technologies such as Integrated Pest Management (IPM) provide such win-win solutions. Similar technologies are needed for nutrient, land, and water management across a wide range of environments and cropping systems. The problem of disseminating such knowledge intensive technologies to subsistence farmers needs particular attention. Farmer will find it worthwhile to invest their time in learning to use these technologies only if the incentive problems described above are solved.

Conclusions

The food security challenge has become a lot more complex today than it was in the 1940s and 1950s. Urbanization, globalization, private sector R&D, on the one hand, and the persistence of poverty and resource degradation on the other, have contributed to the growing complexity of the problem. The target population for food security policy is no longer predominantly the rural poor, its increasingly urban based. Catering to the diversified demands of the populations that are becoming increasingly better off is adding to the challenge of meeting the food needs of the poorest of the poor. The challenges for science and technology are as great today, if not greater, than they were fifty years ago.

Food security is not just a problem of increasing production, it is a problem of improving access, it is a problem of equitable distribution, and it is also a problem of enhancing effective demand of the poorest of the poor for food. Improving opportunities for increasing incomes of the poorest of the poor may be as important to their food security as providing them with new productivity enhancing technologies.

The food security equation involves multiple actors. It involves researchers, it involves politicians, it involves local communities, and it also involves multinational corporations. A wide spectrum of shareholders, stakeholders and actors need to be part of the discussion, debate and policy making around food security.