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Future Resource Needs for CGIAR: Preliminary Thoughts

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The world faces a major challenge to feed the projected population of 9 billion people in 2050. FAO estimates that global output of food will increase by approximately 60% relative to 2006. Even this substantial growth in supply does not eliminate hunger because real prices rise, reversing the downward trend observed in the last half of the twentieth century. According to assessments by IFPRI, real food prices rise between 20% and 50% depending on commodity, with maize at the high end. Over 100 million children remain malnourished due to the increased real prices.

A focus on 2050 should not convey a sense of complacency about the intervening decades. The trends that will take us to 2050 are underway even now. The figure of 60% increase in supply by 2050 is a useful benchmark because of its limitations. It is clearly a lower bound to be aimed for, since the resulting increase in real food prices and persistent hunger and malnourishment are not desirable. The implied annual growth rate of about 1.2 percent is not high by historic standards. Achieving even this level of growth, however, will be a major challenge. Recent increased volatility of prices mirrors volatility of production, as extreme events in major growing areas have pushed global average growth down. Extreme events are forecast to continue and perhaps increase in frequency. Unless the strong link between extreme weather events and food production can be broken through development of more resilient technologies, a modest growth rate can be achieved only if good years are considerably better than the targeted trend.

Land for expansion is constrained, although more is available in Africa and Latin America than elsewhere. Soil degradation is an increasing and measurable drag on growth in yields, as years of nutrient depletion, erosion, and poorly managed irrigation leave their legacy. The same growth in population that increases demand for food diverts water away from its production, necessitating emphasis on water management and conservation instead of yield increases. Growth in demand is not evenly spaced, and will be most rapid in Africa south of the Sahara and in rain-fed parts of South Asia. Climate change will hit hard here, and is already doing so. These regions have historically had low rates of productivity growth, and difficulty translating scientific discovery into better practices on the ground. Growing demand for livestock products will lead to increased density of herds, with corresponding higher risks of disease. Added to these pressures on the demand and supply sides will be increased need for qualitative change in food systems to address a wide spectrum of nutritional issues. And the increased pressure on natural resources and heightened interaction between linked components of landscapes will necessitate improved understanding of systemic characteristics and new managerial approaches to food production.

This accretion of challenges and the need to aim for growth in food production higher than 1.2% annually leads inexorably to the conclusion that much of the growth will need to derive from investment in agricultural science and its embodiment in production. Although much can be accomplished through better application of known technologies to land and water already in production, how to do so is itself a matter of research. Even widespread application of the best known technologies will not be sufficient to meet the challenges ahead.

The need for a more science-intensive agriculture raises important questions about the level of investment in science and the organizational architecture required to maximize its impact. Global spending on public agricultural research by developed countries has historically tracked the movements in real prices, and the trend was sharply downward until a recent leveling. Middle income developing countries, in contrast, have increased their spending, as, especially recently, has the private sector.
Aggregate global public spending on agricultural research in 2008 was $31.7 billion (2005 PPP$, 2012 ASTI report). This has probably increased subsequently with the attention to agriculture, particularly in developing countries, following several price shocks. The private sector, largely in OECD countries, spent about $18 billion on agricultural and food research, slightly less than half of which focused on production agriculture (and the remainder on food science and processing). Of this, the big 6 global seed companies spent $3.36 billion in 2011 (Phillips MacDougall Company report). One firm among the big six reports that it spends over $800 million per year on research on row crops, principally on maize and soybeans. With this size of investment it expects to increase yields in its developed country markets by about 2-2.5 percent per year to the end of its planning horizon around 2030. But it also reports that several challenges need to be addressed to maintain this pace, including interactions between climate change and disease, insect and weed pressures and shifts in soil health. Integrated research programs on seed improvement and pest management are needed, especially for small holder farmers where adaptation strategies may require multiple technologies.

For working purposes one could estimate that about $40 billion is spent in the public and private sectors annually on research contributing to growth in production and productivity. Of this, about half is in high income countries, and almost a third in China, India, Brazil, and other Asian and Pacific countries. Only about 5% or $1.6 billion is spent in Africa south of the Sahara. Spending by CGIAR in 2011 was $700 million, and about half of this was devoted to Africa. In other words, in 2011, the research work of CGIAR for all of its mandate crops, livestock, and natural resource systems was of the same order of magnitude as the one major private company noted above. The entire public research effort of Africa south of the Sahara was only twice that.

Food production and consumption are linked globally through trade, but the global integration of agricultural research is less than that of trade in commodities. The reach and scope of private firms is limited by effective demand and by pervasive externalities in pricing of resources essential to agricultural processes. Public funding by national governments even when ample has limited ability to recognize benefits that spill over to other countries. Low income developing countries have historically underinvested for a number of reasons, and have additionally had less success than wealthier countries in converting agricultural science into applied technology. Global agricultural research is thus not configured adequately to recognize the global interdependence of food systems. Water, forests, biodiversity, and carbon are not adequately addressed. Low income countries that depend on agriculture and that have potential to contribute more to global growth do not have the science to do so. These gaps in the architecture will become increasingly costly as the forces shaping demand and supply over the next decades come to bear, and the need for scientific solutions intensifies.

CGIAR’s mandate upon its founding derived from a recognition of the imperfections in the global system, even when those deficiencies were not as costly as they are now and will be in the future. Part of the output of CGIAR is genuinely public agricultural goods that can be used by scientists in many countries and adapted to the specific agro-ecological characteristics of their regions. A second kind of public good recognizes the global benefit of structured scientific partnership with countries that have a sufficient level of scientific capacity to participate constructively in such a partnership, but not yet enough scientific strength or perhaps critical mass to proceed well without it. In surveying the future demands on CGIAR, both these historic elements of the mandate will be important. Attention to the orphan crops and the orphan resources; that is, to the essential elements of the global system that receive too few resources, will need to increase. Focused partnership with scientific organizations in countries and regions where productivity growth has lagged potential will also be required. CGIAR will need a dual emphasis both on priority commodities and systems and on priority areas.
Important among the latter will be Africa south of the Sahara. CGIAR’s four strategic objectives and the overall performance of the global agricultural system can be achieved only if total factor productivity and management of natural resources in Africa improves markedly. African leaders are aware of the importance of agriculture in their region, and commitments to accelerate growth are reflected in the Comprehensive African Agricultural Development Programme. African governments have increased their spending in agriculture, but not sufficiently in research. The African Union is supporting development of a Science Agenda for African Agriculture for presentation to Heads of State in 2014. This will facilitate coordinated reinvestment by national governments in their scientific research institutes, universities, and in personnel. The Science Agenda will highlight needed institutional linkages within Africa, mechanisms to draw in the global private sector, and partnerships with leading research power-houses in the developing world and globally.

CGIAR, through its memorandum of understanding with the African Union, is assisting in design of the Science Agenda for African Agriculture through consultation and technical support to the drafting committee. But even with a well-crafted and adequately resourced plan for reinvestment in Africa, the process will take time. Researchers need to be trained, labs rebuilt, and research programs expanded. Existing work already in the pipeline can be accelerated, and the pathways to move it into use can be cleared. The latter topic; i.e., how better to translate science into productivity change in Africa, is an important area of research itself.

Given time lags inherent in agricultural science, even a strong process of reinvestment will not be able to deliver the science soon enough to support growth in productivity needed today and tomorrow in Africa. Partnerships with global scientific organizations will have to be central to the Science Agenda for African Agriculture in order to draw more fully on the strengths of science elsewhere. The role of the partners will have to be quite substantial initially, probably changing over time as African capacity grows through training and rebuilding. The logical places to look for such partners are in the strong middle income and developing countries where research is growing (China, India, Brazil, and Asia/Pacific), in the private sector, and in CGIAR.

CGIAR can serve directly as a partner and can facilitate partnerships with others. Brazil, China, and India have all expressed interest in contributing to agricultural technical change in Africa, and each has programs on the ground. Each has also struggled to find an effective mechanism of engagement and funding for an increased presence. Private firms are interested in commercial opportunities in Africa, but these are at present hard to structure without further reforms in land rights, intellectual property rights, and regulations regarding new varieties; all topics of research in CGIAR.

The qualitative dimensions of CGIAR’s work in the next decade thus derive directly from the challenges increasingly evident in the review of issues over the horizon to 2050. Among them are the following:

- Deepen understanding of how climate change affects agriculture, and of strategies for adaptation and mitigation.
- Strengthen research on landscapes and systemic interactions within agricultural systems as resources are stressed and interactions become more complex. Better metrics to assess the pressures on natural resources will be needed.
- Improve rigorous quantitative modeling tools supplemented by expert review of underlying assumptions and consultation with farmers to identify best bet technologies and management approaches for accelerated development and release.
- Accelerate yield gains in staples essential for the poor, many of which are orphan crops.
• Improve the nutritional content of foods through biofortification and selection of desirable traits. Emphasize productivity gains in livestock products and nonstaples that deliver nutrition through dietary diversity.

• Better integrate understanding of roles of forestry and fisheries in food security strategies, particularly for low income consumers.

• Structure partnerships with African institutions qualitatively and quantitatively different from the engagement in the recent past. CGIAR should help with the training needs for implementation of the African Science Agenda, should assist in accelerating the flow of new technologies relevant particularly over the next ten years, and provide focused research to underpin institutional reforms to increase rates of return to scientific research in African agriculture.

Each of these areas of emphasis represents a continuation of work that CGIAR knows and is already doing, but also a step change in the level of commitment and accountability for results.

If these strategic directions are validated through consultation, quantitative assessment of the level of resources needed to deliver on them can be undertaken. The techniques and approaches discussed at the Food Security Futures conference convened by CGIAR and FAO in Dublin April 11-12, 2013 by representatives of academia, the private sector, national agricultural research systems, and civil society organizations will be relevant. Key elements of the research work to assess priorities and funding needs will include the following work ongoing under the Consortium Research Program on Policies, Institutions, and Markets, as well as other work:

• Continuation of the modeling started under the Global Futures Project, and carried forward in the foresight modeling under PIM. This effort combines bio-physical models, the economic and social modeling under IFPRI’s IMPACT model, and the findings of climate models to identify “best bet” technologies that will deliver growth in yields and output to dampen the foreseen increase in real prices;

• Supplementation of the modeling work with more qualitative assessments of scenarios that take into account issues of natural resource scarcity not yet incorporated into the models. The outcome of the qualitative work can be developed as various shocks exogenously imposed on the models to enrich results.

• Implications of the above at the regional level, with relaxation of assumptions of full tradability and price transmission. This will help clarify the growth path required in Africa south of the Sahara.

• Quantitative assessment of elasticities of growth in total factor productivity with respect to investment in research at the regional level. Historically a 10% increase in investment in agricultural science has been associated with approximately a 3% increase in TFP, but elasticities have varied by region, with China higher than average, and Africa lower. These elasticities are likely to fall across the board as increased uncertainty associated with climate change reduces the efficiency of agricultural research. Explicit study of factors affecting the elasticities will be important to try to avoid a decline.

• Modeling of adoption of technology. Elasticities noted above may vary due to barriers to adoption, rather than difficulties in generating relevant scientific solutions.

• Examination of scale issues in agricultural research. If, as appears to be the case, new approaches to research require large scale in management of information, this will have implications for the location of different types of investment in capacity, and the partnerships required to access it.
This is a demanding research agenda, and is one of the thematic areas pursued under Consortium Research Program on Policies, Institutions, and Markets. With appropriate simplifying assumptions, early results to guide priorities for CGIAR and to determine the required levels of resources can be developed. These will need to be revised as new work becomes available in each of the topics noted above, and the assessments can be updated on a rolling basis. At this stage and on a heuristic basis, one can conclude that the demands on CGIAR will grow in the coming years because the areas of greatest vulnerability in the future food system are those that fall within the mandate of CGIAR, and are not likely to be adequately covered by other partners.