Consultative Group on International Agricultural Research (CGIAR)

Document No: MTM/01/05-1 Rev. 1
Distribution: General
Date : May 7, 2001

Mid-Term Meeting 2001
May 21 - 25
Durban, South Africa

Charting the CGIAR'S Future – Change Design and Management

The Case for International Agricultural Research in the 21st Century

(Background Document for Agenda Item 2: Change Design and Management in the CGIAR)

Please find attached a paper by Marc J. Cohen and Per Pinstrup-Andersen entitled *"The Case for International Agricultural Research in the 21st Century"*. The report provides context to the discussion on Agenda Item 2: Change Design and Management in the CGIAR.

This item is for Information [X] Discussion [ ] Decision [ ]

Proposed Action: None

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THE CASE FOR INTERNATIONAL AGRICULTURAL RESEARCH IN THE 21ST CENTURY[1]

Marc J. Cohen and Per Pinstrup-Andersen[2]

Thirty years ago, the threat of famine loomed over South Asia and much of Africa. To address this looming food crisis, 18 governments, international organizations, and foundations joined together with four International Agricultural Research Centers (IARCs) to create the Consultative Group on International Agricultural Research (CGIAR). Since then, global food production has increased by 80 percent, per capita calorie consumption in developing countries has risen by 26 percent, and the incidence of chronic undernutrition in the developing world has declined from 37 to 18 percent. Widespread adoption of yield enhancing technology generated by the CGIAR system and its partners in the national agricultural research systems (NARS) of developing countries has permitted the preservation of over 300 million hectares (equivalent to the farmland of the United States, Canada, and Brazil combined) of ecologically fragile land in developing countries that would otherwise have been cultivated. The system, now with 58 members, including 20 developing country governments, and supporting 16 IARCs, contributes substantially to the preservation of biodiversity, partly by the above land preservation and partly through CGIAR-supported IARC gene banks, which contain over 600,000 accessions of more than 3,000 plant species. The centers also work directly with developing country farmers and communities on *in situ* conservation of plant genetic resources.

As a publicly funded network, financed by taxpayers from both the South and the North and by philanthropic institutions, the research outputs of the system constitute "international public goods." Economists use the term public goods to characterize goods and services that one person can consume without detracting from the consumption of another. It is also impossible or very difficult to exclude anybody from consuming such goods and services. Typical examples are national defense services, street lighting, and environmental protection. New knowledge created by CGIAR centers is made freely available to all, including public policy makers, for the benefit of the global public, especially poor people, and can be used over and over again. The centers' outputs are international in character because their relevance transcends national boundaries.

Today, the world faces very different food and agriculture challenges and a radically changed agricultural research environment. Nevertheless, the case for a network of public agricultural research centers, producing international public goods, remains compelling and essential to achieving the goal of a food secure world.

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[1] Prepared for the Chairman of the Consultative Group on International Agricultural Research (CGIAR), April 5, 2001; revised as of May 10, 2001.

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Current State of Global Food Insecurity and Prospects to 2020

Global food production has been adequate every year since 1974 to permit everyone to meet their minimum calorie requirements if the available food were distributed according to need. In 1996, 2,600 calories were available per person per day in developing countries, compared to minimum requirements of 2,200 calories. It is projected that the figure will rise to 2,800 calories by 2020.

Despite continuing gains in food availability, in 1997 (the last year for which data are available), 792 million people in developing countries remained food insecure. The number of undernourished people in developing countries has declined from 937 million in 1980. Over 60 percent of the food insecure people live in South Asia and Sub-Saharan Africa. In the latter region, the food insecure population jumped nearly 50 percent between 1980 and 1997, from 125 million to 186 million people.

Hunger persists in the face of adequate food supplies primarily because food insecure people are too poor to afford the food that is available, although they spend the bulk of their incomes on food, and they do not have access to resources, such as land, water, and credit, to produce food for themselves. Nearly 1.2 billion people in the developing countries live on the equivalent of less than $1 a day, unable to meet their basic needs on a sustainable basis. Sixty-eight percent of these absolutely poor people live in South Asia and Sub-Saharan Africa, and 70 percent are female. Unless economic growth accelerates and inequality is reduced, the number of poor people is likely to remain unchanged over the next decade. Poverty is likely to remain entrenched in South Asia and Latin America, and to increase considerably in Africa, where average income per person will remain under a dollar a day.

Despite rapid urbanization in developing countries, 75 percent of the people living in poverty remain in rural areas, depending directly or indirectly on agriculture, fisheries, and forests. The majority of poor people in developing countries will remain rural through at least 2035, although a majority of the overall population will be urban by 2020. Rainfed and smallholder farmers, pastoralists, artisanal fisherfolk, landless laborers, indigenous people, people in female-headed households, and displaced persons are the rural people most affected by poverty.

It is anticipated that by the year 2015, the number of undernourished people in developing countries will fall to 576 million, or 10 percent of the population in the developing world. Although below current levels of food insecurity, this is far short of the 1996 World Food Summit goal, reducing the number of hungry people by half by no later than 2015. The center of gravity of hunger will remain squarely in South Asia and Sub-Saharan Africa, as these two regions will be home to 61 percent of all food insecure people. Twenty-two percent of all Africans (184 million people) will face undernutrition.

Of particular concern are the 150 million malnourished preschool children in developing countries. Malnutrition is a factor in 5 million child deaths annually, and those who survive face impaired physical and mental development. Food insecurity robs humanity

of countless scientists, artists, community and national leaders, and productive workers. Without significant changes in national and international policies, by 2020, the number of malnourished preschoolers in the developing world will fall only about 10 percent, to 135 million. This means that every fourth child will still be malnourished, compared to one in three in 1995. Child malnutrition is expected to decline in all developing regions except Sub-Saharan Africa, where the number of malnourished children is forecast to increase by 25 percent. Sub-Saharan Africa and South Asia will be home to 77 percent of all malnourished children.

Micronutrient malnutrition is a very serious problem in the developing world. Anemia, usually due to inadequate dietary iron, affects 56 percent of the pregnant women (and 76 percent of pregnant women in South and Southeast Asia). Anemic women face a heightened risk of maternal mortality, and their babies are more likely to be premature, have low birth weights, and die as newborns. The incidence of anemia is also high among South Asian infants and children. Anemia can impair child health and development, limit learning capacity, impair immune systems, and reduce work performance. Even when iron deficiency does not progress to anemia, it can reduce work performance. Iron deficiency results in annual economic losses as high as 2 percent of gross domestic product in some developing countries.

Insufficient intake of vitamin A among children in developing countries is the leading cause of preventable severe visual impairment and blindness and contributes to infections and death. Pregnant women who are vitamin A deficient face increased risk of mortality and mother-to-child HIV transmission. Vitamin A deficiency impairs the immune system and increases the severity of HIV/AIDS, malaria, and other illnesses. Over 100 million children are vitamin A deficient, and 250,000-500,000 go blind every year as a result. About half of the children who suffer from vitamin A blindness die within a year of losing their eyesight.

Food Supply and Demand to 2020

Global cereal demand is likely to increase by 39 percent between 1995 and 2020, while demand for meat will increase by 58 percent, and demand for roots and tubers will grow by 37 percent. These increases in demand will stem from population growth, urbanization, income growth, and associated changes in dietary preferences. Most of the increased demand will come from developing countries.

World population will reach 7.6 billion in 2020, with virtually all of the growth taking place in developing countries. Urban population in developing countries is expected to double between 1995 and 2020. When people move to cities, they tend to shift consumption to foods that require less preparation time, and to more meat, milk, fruit, and vegetables. Prospects for economic growth appear favorable in the developing world, and like urbanization, rising incomes will push people toward more diversified diets.

A demand-driven livestock revolution is underway in the developing world. Between the early 1970s and the mid-1990s, the volume of meat consumed in the developing countries grew almost three times as much as it did in the developed countries. In per capita terms, demand for meat in developing countries will rise 40 percent between 1995 and 2000. As a direct consequence, demand for cereals for feeding livestock will double in developing countries between 1995 and 2020. Demand for cereals for direct human consumption will increase by 40 percent. To meet this surge in demand, the world's farmers will have to produce 40 percent more grain in 2020. Most of the increased output will have to come from yield gains, as ecologically and economically sound opportunities for expanding cultivated area are limited in most developing countries, and virtually nonexistent in many Asian countries.

The demand for fish has outstripped the supply from natural sources in most developing countries. Aquaculture, particularly in Asia, is helping meet the growing demand. In Africa, aquaculture development is showing potential, but so far development has been modest and has not been sufficient to reverse a per capita decline in fish availability since the early 1980s. Since the mid-1980s, more fish has been produced in developing countries than in developed countries. International trade redistributes 40% of world fish production, much of it going from developing to developed countries.

The rate of increase in cereal yields is slowing. This is due in part to reduced use of inputs such as fertilizer, reflecting low and falling cereal prices since the late 1990s, and partly to low levels of investment in agricultural research and technology. Small farmers in developing countries face many problems that lead to low productivity. Low soil fertility and lack of access to plant nutrients, along with acid, salinated, and waterlogged soils and drought and pests, contribute to low yields, production risks, and natural resource degradation. Inadequate infrastructure, land tenure biased against poor people, poorly functioning markets, and lack of access to credit, extension services, and technical assistance add impediments. Agricultural research, including relevant socio-economic and policy research, can help devise solutions to these problems. Without substantial and sustained additional investment in agricultural research and broad-based agricultural development, it will become more and more difficult to maintain, let alone increase, cereal yields in the longer term.

Broad-Based Agricultural Development is Key to Poverty Reduction

Expanding the pile of food in the world is no longer the key food security issue. It may therefore seem paradoxical that productivity gains in developing country agriculture remain absolutely essential to achieving universal food security and poverty alleviation. However, given the concentration of poverty in rural areas, broad-based agricultural and rural development must be at the center of any strategy to achieve food security. Even when rural poor people are neither farmers nor farm workers, their livelihoods depend on activities that are closely related to agriculture. Low agricultural productivity in developing countries results in high unit costs of food, poverty, food insecurity, poor nutrition, low farmer and farm worker incomes, little demand for goods and services produced by poor nonagricultural rural households, and urban unemployment and

underemployment. For every new dollar of farm income earned in poor developing countries, income in the economy as a whole rises by up to $2.60, as growing farm demand generates employment, income, and growth economy-wide.

Sound public policies are needed to guarantee that agricultural and rural development is indeed broad-based, creating opportunities and assuring access to resources for small farmers and other poor people, including women farmers, who grow much of the locally produced food in developing countries. Supportive policies must be complemented with investment in human capital, good governance (democratic decision making, the rule of law, transparency, sound public administration, and respect for human rights), as well as trade, macroeconomic, and sectoral policies that do not discriminate against agriculture, fisheries, and sound forest, water, and other natural resource management, and are favorable to poverty reduction and food security. Policies must also provide incentives for sustainable natural resource management, such as secure property rights for small farmers.

Above all, poor people must participate in making decisions and implementing programs that affect them. Development efforts must engage low-income people as active participants, not passive recipients. Polices and programs have a much greater chance of succeeding if the affected people have a sense of ownership in the results. To assure responsive policies, poor people need accountable, democratic organizations that articulate their interests. In addition, poor people can often gain empowerment effectively by making alliances with groups of nonpoor people.

At present, developing countries are underinvesting in agriculture, forests, and fisheries, including research. On average, they devote 7.5 percent of government expenditures to agriculture, and the figure is even lower in Sub-Saharan Africa, where agriculture's contribution to gross domestic output is 30-80 percent.

The Need for Public Agricultural Research

Public investment in agricultural research that can improve small farmers', fishers', and forest users' productivity and reduce production risks in developing countries is especially important for food security. It must join all appropriate scientific tools and methods – including agroecology, integrated natural resource management research, conventional research methods, and the latest advances in modern agricultural biotechnology, including genetic engineering – with better utilization of indigenous knowledge. It is important that poor farmers have access to the full range of approaches to tackling their problems. Research should focus on productivity gains on small farms, emphasizing staple food crops, livestock, fish, and trees. More research must be directed to appropriate technology for sustainable intensification of agriculture in resource-poor areas, where hundreds of millions of poor people live. There is a need for more integrated natural resource management approaches, including the development of appropriate institutions for sustainability in the rural sectors. Past agricultural research focused very little attention on the needs of farmers in these areas.

The private sector is unlikely to undertake much research needed by small farmers and fishers in developing countries because expected gains will not cover costs. However, gains to society and to poor people are high. Social rates of return to agricultural research investment exceed 20 percent per year, compared to long run real interest rates of 3-5 percent for government borrowing. Yet low-income developing countries invest less than 0.5 percent of the value of farm production in agricultural research, compared to 2 percent in higher income countries. Average annual growth rates of public agricultural research expenditures in developing countries fell from 6.4 percent over 1971-81 to 3.9 percent in 1981-91, and for Sub-Saharan Africa, the decline was from 2.5 to 0.8 percent.

It is important to note that the indirect impacts of agricultural research on poverty and food insecurity may be even more important than the direct benefits (or losses) from on-farm technological adoption and changes in agricultural employment. As a result of widespread adoption in Asia of high-yielding cereal varieties, output increased dramatically and unit costs fell. This in turn led to lower food prices, and, over time, increased nonfarm employment opportunities, to the great benefit of poor people. Lower food prices were not only beneficial to nonfarm poor consumers, but they helped many poor farmers who were net purchasers of food. For farmers who produced as much or more than they sold, lower prices did not necessarily mean losses where technical advances allowed them to reduce costs of production.

Furthermore, recent research shows that during the period 1970-95, improvements in per capita food availability accounted for 26 percent of the reduction in child malnutrition in developing countries. Improvements in women's education combined with increased per capita food availability accounted for nearly 70 percent of the reduction. So agricultural research can have far-reaching and multi-dimensional contributions to food security.

Also, agricultural research can have an important bearing on widespread micronutrient malnutrition in developing countries. Food-based approaches, including efforts to breed micronutrient-dense staple crops and add high quality animal protein sources such as fish and meat, offer the most sustainable solutions.

A Changed Environment for International Public Agricultural Research

The environment in which IARCs now operate has changed dramatically from that of 30 years ago. Then, official development assistance was relatively plentiful, agricultural, fisheries, and forest research was largely carried out in the public domain, and the environmental impact of agricultural technology was not always carefully considered.

Declining aid and donor benefits. Since the end of the Cold War, aid from the principal industrialized country donors has declined, with aid to agriculture and rural development shrinking by almost half over 1986-97. The share of aid going to agriculture dropped from 25 to 14 percent. Between 1990 and 2000, support for CGIAR-supported IARCs declined by about 10 percent in real terms.

More recently, it appears that overall aid levels have stabilized, and aid to agriculture has increased somewhat. Funding for CGIAR-supported centers has been stable in nominal terms since the mid-1990s. Nevertheless, overall aid remains below mid-1990s levels, and in real terms, aid to agriculture and to international agricultural research remains well below where it stood 15 years ago.

Ironically, aid to developing country agriculture not only is effective in promoting sustainable development and poverty alleviation, but it leads to increased export opportunities for developed countries as well, including increased agricultural exports, as agricultural growth spurs more general economic growth and demand for food products. Every dollar invested in agricultural research in developing countries increases their imports of goods and services by more than $4, with $1 going to agricultural imports. Investments in international agricultural research directly and handsomely benefit consumers and farmers in the donor countries, not only because of higher exports and related income and employment, but also because crop varieties bred for use in developing countries may prove beneficial in industrialized countries as well. For example, every dollar invested in international wheat research by the United States has meant $190 in benefits for U.S. consumers and farmers; investments in rice research have had a $17 return per dollar invested, as U.S. farmers have joined their counterparts in Asia and Latin America in widely planting IARC-bred varieties.

Recognition of the importance of environmental factors. Since the 1972 Stockholm Conference, the 1987 report of the World Commission on Environment and Development, and especially the 1992 Rio Conference, environmental considerations have become increasingly integrated into international development policy. Agricultural growth, poverty alleviation, and environmental sustainability are not necessarily complementary, and achieving all three simultaneously cannot be taken for granted. Much depends on specific social, economic, and agroecological circumstances. Nevertheless, a high degree of complementarity is more likely to be achieved when agricultural, fisheries, and forest development is broadly-based and inclusive of small- and medium-sized farms and small-scale fishers, market-driven, participatory and decentralized, and driven by technological change that enhances productivity but does not degrade the natural resource base. In order to achieve this, research must pay greater attention to sustainability features of technology, to broader aspects of natural resource management at the watershed and landscape levels, and to problems of resource-poor areas. Environmental and sustainability concerns now play a very significant role in the research by CGIAR centers.

Privatization of research. Rapid changes are taking place in the financing, management, and organization of agricultural research, the proprietary nature of the agricultural sciences, and the nature of the biological sciences themselves. These changes are placing an increasing share of agricultural research and the ownership of new technologies in the private domain, raising concerns about the extent to which agricultural R&D will help eliminate hunger for the world's poor people in the decades to come. At the same time, biotechnology, information and communication technologies, and energy technologies offer new opportunities that could benefit poor people, their food security, and natural

resource management, if public policies are in place to assure that poor people can reap these benefits. These developments further increase the need for publicly funded agricultural research focused on solving poor people's problems.

New players. At the same time, new actors have taken on an important role in agricultural research, including nongovernmental organizations and other civil society groups, national agricultural research systems (NARS) in the developing countries, regional institutions, and informal networks at both the regional and global level. Priority setting and research activities in the future must increasingly be carried out in collaboration with these stakeholders.

Looking Ahead

The CGIAR-supported IARCs, in collaboration with the NARS and other partners, have made a substantial contribution to increased food availability, reduced food insecurity, improved child nutrition, and protecting the environment and biodiversity over the past 30 years. Continued creation of international public goods for food and agriculture remains essential to the goal of sustainable food security for all. The nearly 800 million people who remain food insecure are overwhelmingly rural, and many live in resource-poor areas that past agricultural research has largely bypassed. New knowledge and technology can play an important role in tackling the widespread problem of micronutrient malnutrition. But the context for international agricultural research has changed dramatically since the establishment of the CGIAR. The system must change in order to adapt to this new operating environment, so that it can continue to fulfill its important mission of carrying out agricultural research that contributes to sustainable food security and poverty reduction in the developing countries. Changes must respond directly to the more difficult funding environment, the need to integrate sound management of the natural resource base upon which rural livelihoods depend into research, and an increasingly privatized research context.

In particular, it is essential that donors of official development assistance and developing country governments increase their support for public agricultural research. At the same time, it is critical that non-traditional funding sources be explored, including both private philanthropy and support from the private sector. There are a number of mechanisms whereby the private sector can support the creation of public goods, for example public financing of private research wherein the public sector agrees to purchase exclusive rights to the results for distribution in developing countries, while the private sector agrees to undertake the risk. Also, the private sector might be willing to license new technologies to CGIAR supported research centers for use in developing countries with little profit potential on a no-cost basis.

With regard to sustainable natural resource management, the system is already playing an important role in such areas as the development of crop varieties better able to withstand biotic and abiotic stresses, research on developing varieties that need lower levels of external inputs, critical work in the areas of integrated pest management and preservation of plant genetic resources and other forms of biodiversity, research on environmental

services provided by agriculture, and socioeconomic research on the role of property rights and collective action in natural resource management, to name a few key areas. It is critical to intensify such work in the future, through holistic approaches such as integrated natural resource management, working closely with partners in the developing countries, including small farmer organizations and the NARS.