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AGRICULTURE AND NATURAL RESOURCES MANAGEMENT RESEARCH PRIORITIES DESKTOP REVIEW

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CONTENTS

Volume I

Volume II

LIST OF TABLES

Volume I

Volume 2

VOLUME I

ACRONYMS

AARINENA	Association of Agricultural Research Institutions in the Near East and North Africa
AGR	Agriculture
ALO	Association Liaison Office
APAARI	Asia-Pacific Association of Agricultural Research Institutions
ARD	Agricultural Research for Development
ARS	Agricultural Research Service
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AVRDC	Asian Vegetable Research and Development Center
BBP	Biotechnology and Biosafety Program (a CORAF/WECARD proposal)
BIFAD	Board for International Food and Agriculture Development
CAADP	Comprehensive Africa Agriculture Development Programme
CABIO	Collaborative Agricultural Biotechnology Initiative
CAC	Central Asia and the Caucasus
CBNRM	Community-Based Natural Resources Management
CBO	Community-Based Organization
CDR	US-Israel Cooperative Development Research Program
CGIAR	Consultative Group on International Agricultural Research
CORAF/WECARD	Conseil Ouest et Centre Africain pour la Recherche et le Developpement/West and Central African Council for Agricultural Research and Development
CRSP	Collaborative Research Support Program
CTO	Cognizant Technical Officer
CWANA	Central and West Asia and North Africa
EC	European Commission
EGAD	Economic Growth and Agricultural Development
EGAT	Economic Growth, Agriculture, and Trade
EIARD	European Initiative for Agriculture Research for Development
ENV	Environment Office
EPIQ	Environmental Policy and Institutional Strengthening
FAO	Food and Agriculture Organisation
FARA	Forum for Agricultural Research in Africa
FO	Farmer Organization
GFAR	Global Forum on Agricultural Research

GM	Genetically Modified
GMO	Genetically Modified Organism
HPR	Host Plant Resistance
HVC	High Value Crops
IARC	International Agriculture Research Center
IAASTD	International Agricultural Assessment of Science and Technology for Development
IICA	Inter-American Institute for Cooperation on Agriculture
IP	Intellectual Property
IPR	Intellectual Property Rights
IPM	Integrated Pest Management
IQC	Indefinite Quantity Contract
IRG	International Resources Group
LAC	Latin America and the Caribbean
MAPP	Multi-Country African Agricultural Productivity Program
MDG	Millennium Development Goals
MERC	Middle East Regional Cooperation Program
NARS	National Agricultural Systems
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
NRBI	Natural Resource-Based Industries
NRM	Natural Resources Management
NTAE	Non-Traditional Agro-Exports
PFID	Partnership for Food Industry Development
RAISE	Rural and Agricultural Incomes with a Sustainable Environment
REDSO	Regional Economic Development Services Office
SAKSS	Strategic Analysis and Knowledge Support Systems
SARE	Sustainable Agriculture Research and Education Program
SPAAR	Special Programme for African Agricultural Research
SPARE	Strategic Partnership on Agricultural Research and Education
SPFS	Special Programme for Food Security
SSA	Sub-Saharan Africa
S&T	Science and Technology
TT	Technology Transfer
US	United States
USAID	United States Agency for International Development

USDA	United States Department of Agriculture
WANA	West Asia North Africa
WCA	West and Central Africa
WFS	World Food Summit
WVC	World Vegetable Center

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At the workshop on June 8th to review the first (consultation) draft, approximately one hundred stakeholders from US universities and other partners participated in a spirited discussion of the report and provided much needed feedback and additional perspectives. Several significant additions and changes were subsequently made to the report. Many others, too numerous to list, within the ranks of the USAID AGR, ESP, and NRM offices, in the US university community, especially among the CRSPs, the CGIAR, and the international agricultural research community are thanked for their willingness to provide documentation for and commentary on various stages of the process.

EXECUTIVE SUMMARY

This report gives a partial overview of current thinking by key donors, universities, and research organizations on development and research priorities in agricultural and natural resources management. It is intended to assist USAID in identifying the priority topics that would warrant Agency support in order to achieve the greatest impact on smallholder-oriented agricultural growth and rural development.

There is an emerging consensus within the donor community that research on agricultural and natural resources management problems should play a key role in helping to meet the Millennium Development Goals (MDG). For example, last year's June 2004 G8 Action Plan, "recognizes the essential contribution of agricultural research to the MDGs, and calls on its members to develop agricultural science and technology, in order to raise agricultural productivity, particularly in Africa" (EIARD 2004: 3).

This broad agreement about means and ends does not translate easily into prescriptions for funding the "best," the most productive, or the most profitable agricultural or NRM activities, particularly with respect to research. There are a wide range of potential research directions to investigate, depending upon site-specific conditions, as well as the quality of national levels of education and connectivity, appropriateness of enabling policies, the strength of supporting financial, entrepreneurial, and physical infrastructure, the relative degree of institutional strength, and donors' funding and programmatic priorities (UN 2005c).

Global research themes were identified and organized by development-oriented criteria, resulting in four broad categories:

- Macro policies that enable growth to take place;
- Technologies that provide new growth opportunities;
- Policies, institutions, and technologies that sustain the natural resource base;
- Policies and institutions that enable economic growth and natural resources management to be pro-poor.

Efforts are needed in all of these four areas to achieve sustainable results. These broad areas were then addressed differently within regions, and it was only within the regional context that prioritization of narrower research objectives were generally presented, as follows:

- In Asia, water use and on-farm water management, income diversification through high-value commodities, productivity of staple foods in less-favored areas, and natural resources management were most frequently addressed.
- In Latin America and the Caribbean, access to markets by the poor, land and property rights and access to rural finance, and natural resources management were key topics.
- In Central and West Asia and North Africa, water use and on-farm water management, crop improvements both for staple commodities and high value crops, income diversification, and access to infrastructure and services, as well as natural resources management were emphasized.
- In Sub-Saharan Africa, greater priority was placed on markets (including access for the poor and links to regional and international markets), water and soil technologies and practices, and crop and animal systems technologies.

The main research areas that emerged as recommended opportunities are:

- Human and institutional capacity-building
- Policies and institutions that help to create pro-growth environments
- Resource access and broadened participation
- New tools (including biotechnology) for genetic enhancement to solve the most difficult plant and animal problems of biotic and abiotic stress and of food quality
- Soil and water use and management
- Staple food crops and livestock in less-favored areas, supported by effective soil and water use and on-farm management of these resources, together with market development.
- Income diversification through High-Valued Commodities (HVC) to include fish and livestock, relevant soil/water use/on-farm management, food quality and safety, with value chains influencing respective markets.

These areas are not presented in a rank order. As a group, the listed topics have been considered for portfolio balance. They are listed individually to emphasize the importance of each topic, but several would often, if not usually be implemented as integrated research packages to enhance likelihood of adoption and broad impact, nearly always through partnership organizations. The specific topics within these broad categories would be differently arrayed in each region. The team sees research in all seven areas as essential to building a research portfolio with the ultimate goal of contributing to sustainable development that enhances agricultural productivity while also sustaining the natural resource base.

INTRODUCTION

After nearly a decade of decline in support to agricultural research and agricultural programming in USAID and the wider development community from the mid-1980s to the mid-1990s[1] (Alex 1997, USAID 2003), the international consensus around the Millennium Development Goals (MDGs) has shown renewed interest in the importance of agriculture and natural resources management to help in reducing poverty. A recent review paper on rural development states this directly:

> *Although in the longer term a broad transformation and diversification of rural economies away from a strong dependence on agriculture is desirable, more immediate gains in the welfare of poor households are most likely to come through the poor overcoming some of the critical constraints they now face in meeting their basic needs through agriculture. Thus, a necessary component in meeting the MDGs by 2015 in many parts of the world is a more productive and profitable agricultural sector (World Bank 2005: 16).*

Furthermore, the ability of the agricultural sector to transform rural economies and the lives of rural producers is intimately linked to application of both existing and new knowledge from the agricultural and environmental sciences. There is an emerging consensus within the donor community that research on agricultural and natural resources management problems can and should play a key role in helping to meet the MDGs and to reduce poverty, raise incomes, and achieve more sustainable development. For example, last year's June 2004 G8 Action Plan, "recognizes the essential contribution of agricultural research to the MDGs, and calls on its members to develop agricultural science and technology, in order to raise agricultural productivity, particularly in Africa" (EIARD 2004: 3).

This broad agreement about means and ends does not translate easily into prescriptions for funding the "best," the most productive, or the most profitable agricultural or NRM activities, particularly with respect to research. There are a wide range of potential directions to investigate and approaches to take, depending upon, among a number of variables, site-specific conditions, quality of national levels of education and connectivity, appropriateness of enabling policies, strength of supporting financial, entrepreneurial, and physical infrastructure, a relative degree of institutional strength, and donors' funding and programmatic priorities (UN 2005c).

This report gives a partial overview of current thinking by key donors, universities, and research organizations on development and research priorities in agricultural and natural resources management. It is intended to assist USAID in identifying which priority topics would merit consideration of Agency support in order to achieve the greatest impact on smallholder-oriented agricultural growth.

In presenting the results of the priority-setting processes reviewed in this report, the authors have made a fundamental assumption that research can and does contribute to the achievement of development goals. Research that leads to relevant gains in knowledge can contribute positively to the development process. It is the research challenge to uncover the information needed to address the many important topics on the development agenda. Scientific research (including both the natural and social sciences) can provide answers about which interventions, among many possibilities, have the higher payoff in achieving desired development results. If the research agenda is identified and executed successfully, the development agenda will more likely be implemented successfully, although it may take a relatively long time horizon and it may encounter many closed doors before achieving that success.

[1] "Although year-to-year comparisons are difficult due to changes in the components of what is defined as agriculture, the overall trend is absolutely clear. USAID agricultural funding declined from a high in FY 1985 of about $1.2 billion, bottomed out in FY 1997 at $145 million, and has been trending upward in the last five years…" (USAID 2003: 4).

USAID is not a research institution but rather an agency with a development agenda that also funds research. The five operational goals of US foreign assistance are to promote transformational development, strengthen fragile states, provide humanitarian relief, support US geo-strategic interests, and to mitigate global and transnational ills.[2] Some of the questions that this report raises for USAID and its stakeholders to discuss and, perhaps, answer are: what kind of research, how much of it, and through what mechanisms should it be carried out to help achieve these USAID development goals?

The review uses the broad definition of agriculture articulated in Title XII of the Foreign Assistance Act of 1961, amended in 2000, which acknowledges the growing complexity and interrelatedness of agricultural activities occurring in the world and supported by USAID's foreign assistance programs.[3] It builds on the framework presented in the recently completed USAID Agriculture Strategy, "Linking Producers to Markets," with its articulation of four central themes of expanding markets and trade, improving the sustainability of agriculture, mobilizing agricultural science and technologies, and strengthening agricultural outreach, education, and adaptive research.

STRUCTURE OF THE REPORT

The final report has five sections. It opens with this brief introductory section outlining the past and present context of USAID support to agricultural research. The second section, "Looking to the Future: Emerging Trends in Agriculture and Natural Resources Management," reviews what is projected for agricultural and environmental conditions for the future.

The third section is the main body of the report. It draws on summaries of key documents (concentrating on those prepared in the past five years) by major donors and research and regional organizations that identified priority topics in agriculture and NRM research. This section reports on areas of agreement that emerged from review of these documents. It begins with a review of global themes and then turns to regional priorities. As requested in the SOW, the summary of each document reviewed is included in the report (Volume II). Each summary identifies the process used to establish the priorities reported on and the degree of participation from stakeholders involved in the process.

A number of caveats are needed, however. With some exceptions, the source documents turned out to be significantly less clear about identifying research priorities than the review team expected. At the global level, the larger majority addressed broad development goals, with only suggestions about wide categories of research. Many emphasized the need for further involvement with stakeholders about specific research priorities at the regional and/or national level. While the team also reviewed a number of regional documents, there was not sufficient time to do an in-depth review and the materials were of uneven quality and focus. This section is thus less analytical and more suggestive than was initially intended.

The fourth section briefly describes recently issued US and USAID policy and strategy documents such as the work surrounding the World Food Summit, the USAID Agency Agricultural Strategy, the White Paper on "US Foreign Aid: Meeting the Challenges of the Twenty-first Century" and the Fragile States Strategy, that provide guidance for interventions in the agriculture and natural resources management sectors. It identifies the comparative advantages of the US and USAID to mobilize resources to support agricultural and natural resources research.

Finally, the fifth section of the report, the "Opportunities Assessment" suggests a set of criteria that can be used by USAID to develop a list of priority topics in AG/NRM research. It also presents suggested priorities (we term them "opportunities") for consideration by USAID based on the judgement of the team that emerged from the review of the priority setting documents.

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[2] As stated in the USAID White Paper, "US Foreign Aid: Meeting the Challenges of the Twenty-First Century" (January 2004), page 5.

[3] Title XII, Amended (2000), Section 296 (g) Definition of Agriculture: As used in this title, the term 'agriculture' includes the science and practice of activity related to food, feed, and fiber production, processing, marketing, distribution, utilization, and trade, and also includes family and consumer sciences, nutrition, food science and engineering, agricultural economics and other social sciences, forestry, wildlife, fisheries, aquaculture, floriculture, veterinary medicine, and other environmental and natural resources sciences.

USAID SUPPORT TO AGRICULTURAL AND NATURAL RESOURCES MANAGEMENT RESEARCH AND DEVELOPMENT ACTIVITIES

USAID has a long history of supporting research in agriculture and natural resources management (NRM). Funding has three main sources: central bureaus/pillars (EGAT), regional bureaus (e.g., Africa Bureau, LAC Bureau, etc.) and missions (including regional field missions such as REDSO). A significant share of the central funding has gone to the Collaborative Research Support Programs (CRSPs), and its network of universities and other partners, and to International Agricultural Research Centers (IARCs), and the Consultative Group on International Agricultural Research (CGIAR) alliance. EGAT has also supported two additional research programs, the Middle East Regional Cooperation Program (MERC) and the US-Israel Cooperative Development Research Program (CDR). Other funded activities have supported National Agricultural Research Systems (NARS), regional networks, such as the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), and non-CGIAR IARCs like the World Vegetable Center[4] and the International Centre of Insect Physiology and Ecology, among others. USAID has also supported research programs or activities not affiliated with either the CRSPs or the IARCs, such as the university partnerships of the Association Liaison Office (ALO), many of which have been on agricultural and natural resources management themes (through the Office of Education). Over time, priorities for USAID-funded programs in agriculture have shifted from extension, irrigation, and basic crop research in the early phases of some of the commodity CRSPs, to broader approaches in food security (e.g., the Food Security I, II, and III projects). Today, support to research covers a wide range of topics, from research on improving market linkages in crop production chains (e.g., the PFID program based at Michigan State University and work done by several of the CRSPs,[5] exploring research opportunities in horticulture, and emerging topics like biotechnology, such as under the Collaborative Agriculture Biotechnology Initiative (CABIO).

The Agency has reaffirmed its strategic commitment to the agriculture and NRM sectors, both in research and in education and training in the Agency agricultural strategy, in the Initiative to End Hunger in Africa, and in new programs for both short-term and long-term training (e.g., the Borlaug Fellows Program with USDA and the three new long-term training activities in Africa). The individual donor-driven agenda of the past is slowly shifting to a new institutional environment of greater donor coordination and partnership with national and regional organizations, in the achievement of the shared vision stated by the Millennium Development Goals.

[4] Formerly the Asian Vegetable Research and Development Center (AVRDC).

[5] See reviews of the CRSP annual reports in Volume II.

LOOKING TO THE FUTURE: EMERGING TRENDS IN AGRICULTURE AND NATURAL RESOURCES MANAGEMENT[6]

A GLOBAL PERSPECTIVE

Historically, the agricultural sector has been the driving force of economic growth. In low-income countries, production of food, fiber, and animals typically employs three-quarters of the labor force, contributes half of the net national product, absorbs two-fifths of capital formation, and generates three-fifths of exports (including manufactured agricultural products). These characteristics not only reflect both the importance of agriculture in the total economic life in low-income countries, but also indicate the relatively modest level of economic development these countries have achieved. By contrast, production agriculture accounts for less than ten percent of the net national product and only two percent of employment in the United States.

This difference in the relative importance of agriculture in a national economy is the result of making agriculture increasingly efficient. The primary reason is that demand for food and fiber increases at a progressively lower rate as income increases; that is, people spend proportionately less of extra income on food as their incomes increase. Growth in agricultural production is thereby limited unless costs per unit of agricultural products fall. In contrast, demand for many non-agricultural products increases at relatively higher rates.

Changing relative demands combined with changes in productivities in the respective sectors shapes relative prices, and, in turn, influences incomes. Labor is partly "pushed" out of agriculture and more strongly "pulled" into non-farm activities, though many are still closely related to agriculture. Resources are transferred out of agriculture into the non-farm sector, enabling it to grow at an even faster rate than agriculture. Agricultural growth creates employment and raises incomes, not only in the rural producing regions, but more generally throughout the economy.

Improved technologies and practices alone cannot do the entire job of sustainable agricultural development. A combination of improved incentives and policies, reinvigorated institutions, and increased investments must occur if agriculture is to develop and the benefits are to be spread widely. However, without improved technologies, practices, and policies, few development programs will move very far or have lasting effect. Improved technologies, adapted to farmer needs, capabilities and profitability, are a necessary condition for agricultural and rural development as the Green Revolution, which revolutionized agriculture in Asia, demonstrates.

[6] This section borrows heavily, and sometimes directly from FAO, The State of Food Insecurity in the World 2004: monitoring progress towards the World Food Summit and Millennium Development Goals 2004) [2004], Rome, Italy: Food and Agriculture Organization of the United Nations, (referenced as FAO 2004); FAO (2003) [2002] World Agriculture: Towards 2015/2030 Rome, Italy: Food and Agriculture Organization of the United Nations (referenced as FAO 2003); IFPRI, Achieving Sustainable Food Security for All by 2020 (IFPRI 2020) (2002) Washington, DC: International Food Policy Research Institute; and Joachim von Braun, et al. (February 2005) "New Risks and Opportunities for Food Security: Scenario Analyses for 2015 and 2050," 2020 Discussion Paper 39, Washington, DC: International Food Policy Research Institute, Washington, D.C..

The formulation of the Millennium Development Goals, building on the Rome Declaration of the World Food Summit,[7] takes as its first objective the alleviation of poverty and of hunger (UN 2005a). What would the world look like if this commitment to food security for all were effective? It would be a world where every person has access to sufficient food to sustain a healthy and productive life, where malnutrition is absent, and where food originates from efficient, effective, and low-cost food systems that are compatible with the sustainable use of natural resources. The benefits to the poor and hungry are obvious: offering, perhaps for the first time, the possibility of a healthy and productive life. Yet the gains to the well-off also bear mentioning: the result would be a world with less risk of conflict over scarce resources, less need for costly emergency relief, a healthier global economy, less poverty-driven migration, and less environmental degradation (IFPRI 2002:1).

As we approach the mid-term benchmark of that visionary projection, FAO's latest report on the state of food insecurity in the world (FAO 2004) highlights three irrefutable facts:

- The good news is that, despite slow and faltering progress on a global scale, numerous countries in all regions of the developing world have proven that success is possible. More than 30 countries with a total population of over 2.2 billion people have reduced the prevalence of undernourishment by 25 percent and have made significant progress towards meeting the WFS goal.[8] Asia accounts for by far the largest drop in the number of hungry people. But Sub-Saharan Africa boasts the most countries that have brought the prevalence of hunger down by 25 percent or more, although often from very high levels at the outset.

- The bad news is that, to date, efforts to reduce chronic hunger have fallen far short of the pace required to cut the number of hungry by half no later than the year 2015. In the developing worlds, approximately 800 million people — about one person in six — remain undernourished. It is estimated that about half of the world's hungry people are from smallholder farming communities, another 20 percent are rural landless, about 10 percent live in communities whose livelihoods depend upon herding, fishing, or forest resources, and the remaining 20 percent live in cities. Within these communities, hunger disproportionately affects the most vulnerable groups, including children under the age of five, women of childbearing age, and mothers of babies, the sick, and the infirm.

- The costs of not taking strenuous action to reduce hunger are staggering. Every year that hunger continues at present levels, more than 5 million children lose their lives and developing countries lose billions of dollars in lost productivity and earnings.

FAO (2004) is cautiously optimistic about the future. Global progress in nutrition is expected to continue, in parallel with a reduction in poverty as projected by The World Bank.[9] Although progress is expected to be slower than in the past, the incidence of undernourishment is expected to fall from 17 percent of the population of developing countries to 11 percent in 2015 and just 6 percent in 2030. By 2030, three-quarters of the population of the developing world could be living in countries where less than 5 percent of people are undernourished. Sub-Saharan Africa is the exception, however. The numbers of poor rose steeply in Sub-Saharan Africa during the 1990s and seem likely to continue to rise, at least over the near future.[10]

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[7] "Number of undernourished" in the Rome Declaration of the World Food Summit was changed to "proportion of people who suffer from hunger," in the Millennium Development Goal One, "Eradicate extreme hunger and poverty."

[8] Even more massive strides can be reported over a longer period. The proportion of people living in developing countries with average food intakes below 2,200 kcal fell from 57 percent in 1964-66 to just 10 percent in 1997-99.

[9] Much of the decline will be due to development in East and South Asia; about half of the decline of 400 million undernourished projected for East Asia has already occurred.

[10] Incomes are expected to grow very slowly. The numbers living in poverty are expected to rise from 240 million in 1990 to 345 million in 2015. By then, two out of five people in the region will be living in poverty.

Table 1: Proportion and Number of Population Undernourished, 1990–1992, 2000–2002, Anticipated 2015 and 2030[11]

	% Population				Million People			
	90-92	00-02	2015	2030	90-92	00-02	2015	2030
Developing Countries	20	17	11	6	824	815	610	443
Asia	20	16			569	519	330	201
South Asia	26	22	12	6	291	301	195	119
East Asia	16		6	4	277	217	135	82
Sub-Saharan Africa	36	33	23	15	170	204	205	183
Near East and North Africa	8	10	7	5	25	39	37	34
Latin America and Caribbean	13	10	6	4	59	55	40	25
Transition Countries	6	7			23	28		

The world, as a whole, does not yet appear to be reaching ceilings to its main factors of agricultural growth. FAO projects that future production increases will result from increases in land (20 percent), yields (70 percent), and intensification (10 percent).

The following list identifies trends or changes that can be expected in the future:

- Increasing incomes, urbanization, and globalization are having profound influences on consumption patterns (Table 2). As the total caloric intake has increased, so has the proportion of those calories derived from vegetable oils, meat, sugar, and wheat. The rate of demand for cereals is decreasing[12] while demand for high-value commodities, including fruits, vegetables, milk, poultry, eggs, and fish, is increasing rapidly. These consumption changes are occurring at all income levels.

Table 2: Changes in Commodity Composition of Food

kg/capita/year	Cereals	Roots and Tubers	Sugar (raw eq.)	Pulses (dry)	Vegetable Oils and Oilseeds (oil eq.)	Meats (carcass wt)	Milk and Dairy (fresh milk eq.)
Developing Countries							
1997-99	173	67	21.3	6.8	9.9	25.5	45
2030	172	75	25.0	6.6	14.9	36.7	66
South Asia							
1997-99	163	22	26.7	10.9	8.4	5.3	68
2030	183	30	32.2	7.9	14.0	11.7	107
East Asia							
1997-99	199	66	12.4	2.1	9.7	37.7	10
2030	183	61	16.6	2.1	16.3	58.5	18
Sub-Saharan Africa							
1997-99	123	194	9.5	8.8	9.2	9.4	29
2030	141	202	13.0	10.5	12.3	13.4	34

[11] Data for 1990-92 and 2000-02 are from FAO 2004. Data for 2015 and 2030 are from FAO 2003. "Transition Countries" are not included among "Developing Countries."

[12] Although this may change if, in the future, more grains are used to feed the growing livestock (large and small) and aquaculture industries.

kg/capita/year	Cereals	Roots and Tubers	Sugar (raw eq.)	Pulses (dry)	Vegetable Oils and Oilseeds (oil eq.)	Meats (carcass wt)	Milk and Dairy (fresh milk eq.)
Near East and North Africa							
1997-99	209	34	27.6	6.7	12.8	21.2	72
2030	201	33	29.9	6.9	15.7	35.0	90
Latin America and Caribbean							
1997-99	132	62	48.9	11.1	12.5	53.8	110
2030	139	61	47.9	10.6	16.3	76.6	140
Transition Countries							
1997-99	173	104	34.0	1.2	9.3	46.2	159
2030	173	100	36.0	1.1	14.2	60.7	179

Source: FAO 2003: 89

- Tropical Latin America and Sub-Saharan Africa have surpluses of cultivable land to be exploited; West Asia and North Africa and South Asia are much more constrained. Urbanization will compete with agricultural uses of land. Deforestation will continue, but slower.
- Irrigation area can be expanded, irrigation system efficiency can be increased, and on-farm water management can be improved; water resources will be increasingly constraining in West Asia and North Africa and South Asia.
- Chemical fertilizer use will continue to increase slowly.
- Global warming is not expected to depress food availability at the global level, but at national levels there may be significant effects. The potential for crop production may increase in temperate and northerly latitudes, while in parts of the tropics and subtropics, it may decline.
- Animal production, especially poultry, milk, and eggs, is likely to be an increasing source of food.
- By the turn of the century, three-quarters of ocean fish stocks were overfished, depleted, or exploited up to their maximum sustainable yield. Further growth in the marine catch can be only modest. The single most important influence on the future of wild capture fisheries is their governance. Aquaculture will be the main source of increased fish production.
- Commodity and food prices are falling.[13]
- International trade in agricultural products will increase significantly, in part to balance surpluses and deficits, in part to respond to promising new markets. Net cereals imports by developing countries could almost triple over the next 30 years, while their net meat imports might even increase by a factor of almost five. Other products, such as sugar, coffee, fruits, and vegetables, foresee export potential. How much of this export potential will materialize depends on many factors, not least on how much progress will be made during the ongoing rounds of trade negotiations.
- Trends toward dietary convergence and adaptation are being fueled by increasing modernization and concentration of food processing and retail trade. Latin America and Asia, the regions where these trends have been most pronounced, have experienced explosive growth both in investments by transnational food corporations and in the proportion of food sold through supermarkets.

[13] Real world prices of major cereals, such as rice and maize, declined by 29 percent and 30 percent, respectively, between 1982 and 1997 (Von Braun et al. 2005: 1).

- Food safety and quality standards are receiving increasing importance, both in international trade and in domestic markets.

- Domestic policies will have a large influence in determining whether and how countries and particular groups within countries, particularly smallholders and low-income consumers, benefit from globalization and the new institutional changes.

- As people consume more oils, meat, and dairy products and less dietary fiber, consume more fast foods, and prepare fewer home-cooked meals, many developing countries now face a double challenge—widespread hunger on the one hand and rapid increases in diabetes, cardiovascular diseases, and other diet-related diseases on the other. A growing body of evidence suggests that it is the poor who are most at risk, not only of hunger and micronutrient deficiencies, but also of diabetes, obesity, and hypertension.

- Over the next years, many of the natural resource problems associated with agriculture will remain serious. Loss of biodiversity caused by the expansion and intensification of production often continues unabated, even in the developed countries where nature is highly valued and, supposedly, protected. A major factor in improving the use and management of natural resources for greater food security and poverty reduction involves strengthening the local institutions that govern resource use. Systems of property rights and collective action create local incentives for investment in sustainable resource management strategies and improve food security. Both systems affect the application of agricultural technologies and natural resources management practices (von Braun et al. 2005:19; Reid et al. 2005).

- Even under the most optimistic scenarios, social safety nets will be required for "those left behind."

EMERGING AREAS

Some additional areas have emerged as having possibly great potential for impacting agriculture and natural resources management. These include both new tools and technologies and new institutional and/or policy challenges:

TOOLS AND TECHNOLOGIES

Biotechnologies

Nearly all the documents at the regional level agreed on the following points: Biotechnology holds great promise for increasing yields (near term) and yield potential (longer term), especially under conditions of stress – both abiotic (including drought, water logging, soil acidity, salinity, and extreme temperatures) and biotic (pests and diseases). Wider use of genetically modified crops depends on the development of technologies that specifically meet farmer needs in the regions. Where such technologies have been available, adoption has been rapid (e.g., Bt cotton in Asia, Roundup Ready Soybean in Brazil). However, use of genetically modified varieties in most of the regions will also depend on the development of appropriate regulatory capacity by the public sector to address food safety and environmental issues. Investment in technology appropriate for farmers and the establishment of effective, science-based regulatory capacity in the same regions and countries are linked in a circular way. Without functioning regulatory systems, the private sector is unlikely to invest in developing crops appropriate for developing countries. Yet without compelling technology being available, countries may find little internal demand for access by farmers or for development of related regulatory activity. Hence both areas of investment are important. Effective intellectual property regimes are important for any long-term investment, whether for internal innovations or in relation to those originating outside a country. Regional cooperation in intellectual property and biosafety has great potential for simplifying both technology access and agricultural trade.

Nanotechnologies

A new area is the development and application of nanotechnologies to agriculture and NRM. *Nanoscience* is the study of phenomena and manipulation of materials at atomic, molecular, and macromolecular scales; *Nanotechnologies* are the design, characterization, production, and application of structures, devices, and

systems at this level. They are being increasingly utilized in water treatment, energy storage, food processing and storage, vector and pest detection and control, agricultural productivity enhancement, and improving environmental management (UN 2005c: 70-71, 74).

Information and Communications Technology (ICT)

New *information and communications technologies (ICT)* are having profound impacts on information and knowledge transmission in agriculture and natural resources management. New systems are emerging to provide up-to-date market information, weather, and extension information to rural producers, processors, and shippers. For example, innovative work to help pastoralists meet changing market demands uses cell phones, computers, and satellite linkages to monitor livestock forage conditions and herd movements, disease incidence, prices, and market information under the USAID-funded Global Livestock CRSP.[14]

Geographic Information Systems (GIS)

Geographic Information Systems (GIS) are being increasingly used in linking geographic information to agriculture and NRM to help decision makers. GIS systems are piloted in "precision agriculture," allowing farmers to adjust the timing of their cultivation practices as well as the application of pesticides and fertilizers according to the specific requirements of each section of their fields. Such efficient use of inputs not only save money in materials, but also makes labor available for other activities. It is also being employed in synthesizing spatial information with health, poverty, economic, and environmental data to permit more integrated analyses.[15]

NEW CHALLENGES

Changing Quality Standards and Procurement Systems[16]

Supermarkets, both regional and multinational, are rapidly growing in number and geographical distribution and are gaining an increasing share of the retail food market. They are transforming procurement practices that are, in turn, reshaping the production, harvest, and post-harvest practices of developing country producers, particularly of horticultural crops. These changes are occurring, not only among export-oriented producers, but also increasingly among producers selling to local wholesale markets. Centralized product procurement, particularly in the fresh fruits and vegetables (FFV) sector, is creating new market chains that include stringent quality and safety standards. But while there are some clear benefits of these buyer-driven global food chains to the supermarkets and their consumers, there are also questions about the capabilities of the world's smallholders to take advantage of these new trends. A central issue for donors is to identify what appropriate research and intervention strategies can support smallholders' in their greater integration into this segment of the world market.

Developing Green and Environmental Markets

Environmental markets are rising in importance. Although the public sector was historically the primary steward of the environment, private markets are now expanding into this area and creating new opportunities for local people. Green labeling, for example, can bring producers higher prices and provide an incentive for maintaining good environmental practices.[17] Ecotourism, already a part of USAID's economic growth and NRM portfolios, is another example. Water markets are another. A third area is paying local producers for practices and products that protect the environment. The principle behind payments for environmental services (PES) is to allow rural inhabitants to benefit financially from sustainable management of their natural

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[14] This activity has been recognized as a semi-finalist by the Development Gateway Award for ICT (http://home.developmentgateway.org/award).

[15] USAID [2003] "Integrating Natural Resources Management and Agriculture" Title XII: Report to Congress, Fiscal Year 2002. Washington, DC.

[16] OECD/DAC DAC Network on Poverty Reduction (2004) "Supermarkets: Smallholder Participation in the Global Food Value Chain." Paris: OECD/DAC and references by Reardon and Berdegue (2002), Weatherspoon and Reardon (2003) and Vorley and Fox (2004) listed in Annex 4.

[17] USAID [2003] "Integrating Natural Resources Management and Agriculture" Title XII: Report to Congress, Fiscal Year 2002. Washington, DC.

resources while impeding environmental exploitation (CAADP 2003: 75). It includes such practices as paying villagers for protecting community forests that help to sequester carbon, for maintaining biodiversity, for protecting watershed areas, or for promoting collection and sales of sustainable timber and other forest products (Reid et al. 2005; also, BASIS CRSP 2004). Finally, the expansion of markets in organic production is another producer niche. Of the key documents summarized, only the IICA statement referred directly to organic production, a growing subsector in Latin America and Caribbean region. Organic certification standards must evolve to meet world market demand, particularly in the Latin American countries (IICA 2004).

REGIONAL OUTLOOKS

Each developing and transition country faces different challenges in improving its agricultural productivity and natural resources management systems. The following section provides a brief review of the key issues and opportunities in each area.

ASIA

The Asian region, including such giants as China and India, has made much progress but still has the largest number of undernourished people. Over the last decade[18] it has reduced the number of undernourished by 50 million (although suffering a slight setback over the last five years), from 569.2 million to 519.0 million, and the proportion of undernourished in the total population from 20 to 16 percent. Progress extends throughout the region, although there is one notable exception, North Korea, and progress seems to have slowed in some countries, for example, Indonesia, the Philippines, Pakistan, and India, over the most recent years. Afghanistan is recovering from conflict and Nepal is heavily embroiled.

FAO projects continued progress for the Asian region (FAO 2004). Population growth rates have declined, and agricultural production rates are robust. Driven by rising incomes, urbanization, and trade liberalization, the region is undergoing a transformation in consumption from reliance on staple food grains to high-value commodities including fruits, vegetables, milk, poultry, eggs, and fish. Infrastructure, roads and markets, are adequate. New institutional forms, such as contract farming and supermarkets are evolving rapidly. The "White Revolution" has turned India into the world's largest milk producer, largely supplied by smallholders. Governments generally have been committed to agricultural development. Government policies and private markets must adjust and respond. Water availability and management will be a key challenge.

There are adequate numbers of trained scientists and analysts. National agricultural research systems (NARS) adapt technologies and occasionally develop new ones. Some university educational programs in the region, for example the Indian Institute of Technology and Institute of Management are world-class. Think-tanks are common. The NGO community is very strong, especially in Bangladesh. Six key international agricultural research centers – The World Vegetable Center,[19] International Rice Research Institute, the World Fish Center,[20] the Center for International Forestry Research, the International Water Management Institute, and International Crops Research Institute for Semi-Arid Tropics – are headquartered in the region.

LATIN AMERICA AND THE CARIBBEAN

The LAC region presents a relatively optimistic picture. Over the last decade, it has reduced both the number of people undernourished by six million and the proportion of undernourished in the total population from 13 to 10 percent. The countries in Central America have higher proportions of undernourished, largely located in the hill areas. Undernourishment in South America is concentrated in the urban areas. Haiti, by far, has the highest proportion of undernourished in the region.

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18 1990-1992 to 2000-2002 (the latest period for which data are available).

19 Formerly the Asian Vegetable Research and Development Center (AVRDC), not a CGIAR center.

20 Formerly the International Center for Living Aquatic Resources.

FAO projects both a reduction in numbers, from 55 million to 25 million, and in proportion, from 10 percent to just 4 percent, of undernourished for the region from 2002 to 2030.

In Latin America, supermarkets increased their share of retail food sales by almost as much in one decade as the US in 50 years. Supermarkets, largely financed by multinational corporations, now account for over 60 percent of the food trade.

Three of the CGIAR centers – CIMMYT, CIAT, and CIP – are headquartered in the region and several of the CRSPs work with national universities in LAC that are strengthening their agricultural programs, such as Zamorano, in Honduras, providing university level instruction in agriculture and natural resources management. Honduras is also the Central American headquarters of Centro Internacional de Agricultura Tropical (CIAT). EMBRAPA, the Brazilian NARS, is well established and produces work of high quality.

CENTRAL AND WEST ASIA AND NORTH AFRICA

Some countries in West Asia and North Africa appear to be making even less progress than Sub-Saharan Africa in addressing food security. Over the past decade the number of undernourished has increased by half and the proportion of undernourished has increased from eight to ten percent. In one sense, this is deceptive because the region has historically been dependent upon imports for food.[21]

Looking to the future, there is likely to be little decline in numbers of undernourished people, although the proportion will approximately halve. FAO projects that the number of undernourished will decline from 39 million to 34 million and the proportion of undernourished in the population will decline from 10 percent to 5 percent from 2000-02 to 2030.

One of the CGIAR centers, the International Center for Agricultural Research in the Dry Areas (ICARDA), is headquartered in the region.

SUB-SAHARAN AFRICA

Africa has reduced the proportion of undernourished in total population over the past decade, although the number of undernourished has increased by over 30 million. Encouragingly, the most recent pronounced positive change in trends among regions, took place in Sub-Saharan Africa where, between 1995-97 and 2000-02, the rate of increase in the number of undernourished slowed from 5 million per year to 1 million per year. However in 1997-99, 23 of the 30 developing countries with per capita food consumption of below 2,200 kcal were located in Africa.

FAO projects that there is likely to be little or no reduction in the numbers of undernourished people[22] although the proportion will approximately halve by 2030. Population will continue to grow rapidly, declining to only 2.1 percent per year by 2030. Diets are still heavily in cereals and roots and tubers. Land and water are relatively plentiful, although soils are thin and on-farm water management often very inefficient. The Sahel is more vulnerable to poor weather conditions than the Sudan and other East African countries. Infrastructure, roads, and markets are weak, in part, because of low population densities over much of the region. The supply of labor, exacerbated by HIV/AIDS, is often deficient. Too few governments have demonstrated sustained commitment to agricultural development.[23] As of July 2004, most of the 35 countries in the world that faced food crises requiring emergency assistance were concentrated in Africa. The crises they faced were

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[21] With the exception of Turkey, every country in the Near East and North Africa is a net food importer and projects to continue being so in the future.

[22] By 2030, FAO projects a decline of only 11 million in the number of undernourished below that in 1997-99.

[23] In 2003, the Heads of State Summit of the African Union agreed in its Maputo Declaration in the New Partnership for Africa's Development (NEPAD) framework to move forward toward directing ten percent of public expenditures to agriculture, in order to bolster food security on the continent. By contrast, in the 1990s, African governments devoted, on average, just five percent of public expenditures to agriculture (Von Braun et al. 2005:9). In a subset of 20 of the 34 most food-insecure countries (mostly in Africa) for which information on government spending is available for the period 1991-2004, only ten have increased their agriculture spending as a share of total expenditures, whereas ten others have decreased their agricultural outlay (Von Braun, et al. 2005: 12).

a consequence of drought, conflict, or both. Almost all the emergencies had persisted over a prolonged period, with an average duration of nine years.

Research capacity is highly skewed across the continent – a recent review states that 50 percent of the 6,000 NARS scientists in the region are working for only three national systems, in South Africa, Nigeria, and Sudan, with the remaining number working in the other 48 countries. Forty national systems (75 percent) have fewer than 70 scientists (with M.Sc. and above qualifications) and a significant number have fewer than 40 scientists. The report also states that in trying to address the wide range of commodities and obstacles faced by farmers in the respective countries, the NARS programs are too thinly stretched to be effective.[24] Four of the CGIAR centers – the International Institute for Tropical Agriculture, the International Livestock Research Institute, the World Agroforestry Center, and the African Rice Center (WARDA) – are headquartered in the region. In addition, the International Service for National Agricultural Research division of IFPRI is located in Ethiopia.

[24] CGIAR Secretariat 2005 "Draft Report of the CGIAR Sub-Saharan Africa Task Forces – The Teruven Consensus" (March 22).

INTERPRETATION OF DEVELOPMENT ISSUES AND RESEARCH NEEDS AND PRIORITIES

Our agricultural research agendas and institutional systems will need to be focused appropriately to meet an increase in demand that will come at a time when there will probably be less water due to increased demand from other sectors, less arable land due to land degradation and urbanization, less labor due to HIV/AIDS and rural to urban migration, increased feminization of agriculture, increasing levels of acid deposition and tropospheric ozone, and a changing climate with warmer temperatures, increasing variability and more extreme events (International Agriculture Assessment Proposal 2003: 7).

GLOBAL RESEARCH THEMES

PRIORITY-SETTING PROCESSES FOUND IN THIS REVIEW

The sixty-plus statements of agricultural "research" needs and priorities summarized here are highly variable in their approaches and in their summaries of needs. No detailed analysis was done of the methods used in arriving at priorities, but brief statements of approach are mentioned in each document summary (Volume II). Most of the approaches used stakeholder input and priorities screening. In some cases it was an extended and iterative process, described in several of the regional priority statements (e.g., NEPAD/CAADP and APAARI) and for a number of the global programs, particularly those associated with the UN Millennium Task Forces and Assessments. Others were based on a single meeting of widely representative stakeholders and invited experts for input, while a very few relied on expert opinion with some consultation.

Although this review focused primarily on priority-setting exercises completed in the last five years, it also included some key on-going processes, anticipating where other assessments are heading. For example, the International Agricultural Assessment of Science and Technology for Development (IAASTD) process of the World Bank (www.agassessment.org), in June 2005, released the outline of its future report based on its regional consultations, some of which are referenced here (see Volume II). From the outline now circulating, the forthcoming report will have a structure and summary areas very similar to those reported below from this current assessment.

Only a few of the processes of the priorities documents reflect use of quantitative assessment methods. The CGIAR Research Priorities document outlines the six activities of deductive, historical, and inductive processes that were used to "inform" the final (inductive) process that resulted in the priorities set. Of the six, only congruence analysis, used to assess relative market importance of the crop commodities as modified by the FAO poverty rating system, was quantitative and used for input (CGIAR Science Council 2005). The West Asian portion of input into the Asian priorities used a congruence analysis for a portion of that input into the overall inductive priorities process (APAARI 2001). One of the CWANA analyses used a poverty-weighted statistical treatment of survey results to inform its overall inductive conclusions by NARS stakeholders (Belaid et al. 2003). The ASARECA "Strategic Priorities for Growth and Poverty Reduction" is heavily based on a multi-market model that quantifies impacts of productivity-enhancing investments in agriculture known as the Dynamic Research Evaluation for Management (DREAM) model (ASARECA 2004). This latter research was commissioned through IFPRI to achieve quantitative input into priority-setting for eastern Africa as part of the Strategic Analysis and Knowledge Support System of USAID/Africa (SAKSS). Others used quantitative data on demographics, production of goods and services, poverty, and

numerous production ecosystem and environmental descriptors to quantify the extent of the problem or the magnitude and importance of a particular commodity to inform their decision making process. For the current analysis, the extent of the consultative process, the use of analytical data, and corroborating sources were factored into selection of research areas of interest and of priorities.

There are regional differences in numbers and specificity of reports. In regions where there is an extremely strong regional organization as with APAARI in Asia, their priority-setting is given strong consideration in the present analysis. Where donor interest in development is high as in Central Asia, WANA, and SSA, multiple priority-setting activities have been carried out, with reports available and cited here. Latin America has modest priority development activity of a very specific nature at the regional level.

LINKING RESEARCH TO DEVELOPMENT

As noted earlier, research in the agricultural sciences and natural resources management, including social science research, has an important role in contributing to the achievement of development goals. Some of the priority-setting documents specifically addressed research needs. Others, including a few from research institutions, were more properly characterized as summaries of agriculturally-related development problems that could, in all likelihood, be addressed through research. Basic research, research to generate tools and technologies, and research on agricultural development processes combine to form a knowledge-chain continuum leading to development.

The list which follows uses headings that are development-oriented:[25]

- Macro policies that enable growth to take place;
- Technologies that provide new growth opportunities;
- Policies, institutions, and technologies that sustain the natural resource base; and
- Policies and institutions that enable growth and natural resources management to be pro-poor.

All four elements are needed to encourage a sustainable development process that is pro-poor. When applied together, these development factors address MDGs for poverty and hunger (1), gender equality (3), health (5, 6), environmental sustainability (7), and contribute in a major way toward partnership for development (8).

Each heading summarizes a more specific listing of research topics. These specific research topics could then be positioned along a research-development continuum. This organization does not attempt to differentiate degrees of research for most priorities. The distinction between research and development becomes very important in maintaining research focus, particularly in research on sustainable, integrated systems and on natural resources management, where well-planned and executed research leads to the creation of scientific understanding, tools, and technologies which are public goods rather than to location-specific solutions.

Many of the documents reviewed stated or assumed that research outputs are intended for the public domain. In an increasing number of cases, the outputs from CGIAR and national public sector biotechnology research will be covered by intellectual property (IP) protection, but still assumed to be held in public trust through managed access (IRRI/CIMMYT 2002). Restricted-market agreements are being negotiated for much of the IP that goes into locally-produced GM varieties. Many of the biotechnology discussions did not address this issue. Others indicated that IP issues were to be a part of the research, but none were explicit as to how they were to be handled. The issues of "protection to guarantee wide access" are under debate, but there is far from global consensus on how non-private sector institutions will handle such issues.

[25] We appreciate the suggestion by Michael Carter, Director, BASIS CRSP, to use this organization.

RESEARCH PLATFORMS AND PROCESSES

There are strong currents of concern evidenced in many of the documents as to who participates not only in research priority setting, but also in the actual research. This is of major concern to civil society (NGO, CBO, and FO) groups, and is at the top of concerns for the Global Forum on Agricultural Research (GFAR 2003). This is especially critical for most "downstream" research, involving sustainable agriculture/integrated farming systems, and concentrated on natural resources management. All of this research involves social, political, and economic, as well as biogeophysical interactions concerning resource ownership, access, and use. Stakeholder participation is critical, not only to achieving relevant focus, but to eventual public acceptance and adoption (FARA 2004, Belaid et al. 2003). For international donors, funding platforms, processes, and selection of primary grantees/contractors are critical to achieving effective development outcomes and capacity-building. In Africa and the CWANA regions with numerous small countries, the scientific and technological inter-country "spillovers" are critical, making research platforms and collaborative efforts important (Belaid et al. 2003). Consequently, a donor portfolio mix relevant to the types of research and the research platforms that are supported is highly important. Portfolio mix and balance is crucial where USAID has a lead role in national recovery from "shock" situations, where governance is minimal, or development is at a low level, and where the aggregate impact of the portfolio is critical to national well-being and stability. Analysis of research priorities involving disaster relief and humanitarian assistance is clearly beyond the scope of this report.

FRAMEWORK FOR ANALYSIS

This report uses a two-dimensional approach. A common, very general set of four development-oriented scientific subject areas, termed "clustered research themes" is used for the horizontal, cross-cutting dimension and for aggregation of the hundreds of specific research topics found in the priorities literature reviewed. The specificity at this level is limited, and the list of themes is largely a mechanistic way of displaying the universe of findings in an accessible framework. The four themes do not necessarily indicate priorities, as work in each of the four areas contributes to sustainable development. Moreover, the clusters are highly interwoven with cross-cutting research thrusts. The priorities identified in Part 5 have been drawn from each of these clusters.

The most focused research topics are found at the regional level, responding to specific needs. In several cases the regional summaries have addressed eco-regional needs at a sub-region level (APAARI 2002, Belaid et al. 2003, AARINENA 2000, FARA 2004, IICA 2004). The "clustered" research themes are used to aggregate wherever possible at the regional level, since some of USAID's funding channels and platforms are organized by scientific area and some are organized more by a systems orientation. Problem area priorities at the global level tend to be general, as indicated in the cluster headings below.

Greater research specificity occurs in the research-focused topics within clusters. Areas and topics are clustered somewhat differently within each region as suggested by the regional documents. In the write-ups which follow the outline, not all sub-categories are necessarily mentioned, as the discussion of cluster points is beginning a process of moving toward priorities.

GLOBAL RESEARCH THEMATIC CLUSTERS

(1) Macro policies that enable growth to take place

- Science and technology policies
- International trade policies and national economic policies
- Capacity building for both national and civil society institutions
- Food safety and quality (including green labeling protocols)

(2) Technologies that provide new growth opportunities

- Enhancing genetic improvement
  - Improving staple and high value crops (yield capacity, biotic/abiotic stress tolerance)
  - Nutrient density/nutritional quality
- Biotechnology-specific research needs
  - Institutional capacity
  - Specific crop applications
  - Food safety/national protocols and policies
- Developing integrated production systems for enhanced productivity/sustainable agriculture
  - Major food (staple crops)
  - Animal production systems
  - Forest systems (managed for livelihoods, productivity, and genetic conservation)
  - Fisheries and aquaculture
  - High value (primarily horticultural systems)
  - IPM
  - Integrated soil fertility
  - Water use/farm level management

(3) Policies, institutions, and technologies that sustain the natural resource base

- Conserving, protecting, and characterizing genetic biodiversity
  - Special attention to staple crops, underutilized species, and animals and aquatic resources
  - Maintaining ecosystem biodiversity
- Water management
  - River basin/watershed issues and management
  - Coastal zone management
- Reducing land degradation
- Climate change/global warming

(4) Policies and institutions that enable growth and natural resources management to be pro-poor

- Expanding access to markets, including strengthening value chains (post-harvest storage and processing)
- Resource access and tenure security (land, common property, water)
- Rural Finance

GLOBAL RESEARCH THEMATIC CLUSTERS

The "research" areas identified here can be aligned at various points along the research-development continuum. As in the literature reviewed, no attempt is made here to separate them into "degrees" of either research or development.

(1) MACRO POLICIES THAT ENABLE GROWTH TO TAKE PLACE

Good governance within each country and at the international level is essential for sustainable development. At the domestic level, sound environmental, social and economic policies, democratic institutions responsible to the needs of the people, the rule of law, anti-corruption measures, gender equality, and *an enabling environment for investment are the basis for sustainable development* (italics added) (World Summit on Sustainable Development*).*

Science and Technology Policies

The UN Task Force report on Science, Technology, and Innovation (2005c: 177-8) concludes that to achieve the MDGs, developing countries must strategically embrace the role of science and technology in their development efforts. Then, they must begin "improving the policy environment, redesigning infrastructure investment, fostering enterprise development, reforming higher education, supporting inventive activity, and managing technological innovation." Similarly, the European Commission notes a "growing recognition" that technology development needs to be "meshed with social, economic and policy dimension to have impact on beneficiaries" (EIARD 2004). These components are part of the enabling environment that will encourage the emergence, application, and adoption of agricultural and NRM practices leading to greater productivity and sustainable development (CIDA 2003, World Food Summit 1996, International Ag Assessment 2004, World Bank 2003, UN 2005a, and ADB 2002).

Identified research areas include:

- The need to better understand the political and institutional factors that promote or inhibit the use of new ideas (DFID 2005) and specifically that encourage institutions and mechanisms for effectively articulating S&T policies (IAC 2004).
- Formulation of and education about appropriate policies for biotechnology and biosafety (also discussed below) (FAO 2002, NEPAD/CAADP 2003, ICARDA/World Bank 2003). Related policies on food safety and food quality are also critical (IFPRI 2004; for aquaculture, see Costa-Pierce et al. 2003; for horticulture see UC Davis et al. 2005; for Africa, NEPAD/CAADP 2003).
- Policy research at all levels (local, national, international) and its impact on entrepreneurship and productivity, as well as scientific R&D (UN 2005c).
- Investigation of policies on intellectual property (CGIAR 2005, NEPAD/CAADP 2003).
- Investigation of incentives to encourage international cooperation in research, NRM, and the generation of public goods (CGIAR 2005).
- Research to link technology policies and industrial policies (UN 2005c).
- Research to provide better ways to get policy advice to government officials (UN 2005c, AARINENA 2000, NEPAD/CAADP 2003).

International Trade Policies and National Economic Policies

Particularly important are government policies to enhance access for smallholder producers and other agricultural and NRM entrepreneurs to regional and world markets (domestic and international trade policies), as well as to build the capacity of developing country governments in these areas (CIDA 2003, World Food Summit 1996, FAO 2002, UN 2005a). Several sources speak to the policy bias against agriculture in developing countries and the trade barriers put up by developed countries, calling for reform in both

camps (EIARD 2004, World Bank 2003, UN 2005a). Improving national macroeconomic policies is critical (World Bank 2003) to support agricultural trade and market access, as well as markets for agricultural inputs and services, and to facilitate entrepreneurship. Governance in the food and agricultural sector needs to be addressed at the macro, as well as sectoral levels.

Identified research topics include:

- Identifying appropriate policies that encourage transparency and efficiency of food- and agriculture-related public organizations, as well as of public and private operators serving agricultural and food and nutrition security (IFPRI 2004).
- Identifying policies that improve access to global knowledge and technology (ICARDA/World Bank 2003, CAADP 2003).
- The interface between technological change, institutional change, and policy environments (CAADP 2003, AARINENA 2000).
- Policy research on international trade barriers (CIDA 2003); better understanding of trade policies impacts on agriculture (GFAR 2000, CAADP 2003, DFID 2003, UN 2005a).
- Identifying mechanisms to help smallholders offset negative impacts of global change and exploit new opportunities in the global systems (CGIAR 2005, DFID 2003, InterAcademy Council 2004).

Capacity Building for Both National and Civil Society Institutions

A majority of the documents supported the development goal of building capacity of their people in the agricultural sciences and various disciplines related to natural resources management and in related policy fields, as well as in the capacity of developing country institutions (CGIAR SSA Challenge Program 2004, NRC 2003, UN 2005c). The Commission on Africa asserts "the need for capacity building and accountability are primary areas of change that influence all sectors and programs within them" (2005). Both the CWANA document (ICARDA/World Bank 2003) and that by APAARI (2002) lists scientific capacity building as one of its cross-cutting priorities.

Identified research topics include:

- Effort to enhance support that builds capacity for developing country scientific and policy capacity (DFID 2005, UN 2005a, ICARDA/World Bank 2003, AARINENA 2000).
- Support to collaborative research, "shown to contribute most to capacity building, for example, when the subject is tied to a problem or issue to which the developing country has direct experience and some indigenous capacity exists" (UN 2005c:30).
- Investigation into producer organizations (CAADP 2003); functioning of producer organizations and other rural institutions and their governance (CGIAR 2005, UC Davis et al. 2005, DFID 2003).
- Investigation into rural institutions (CGIAR 2005, IFAD 2001).

Food Safety and Quality

Almost all donors and regions articulated a need for greater attention to food safety and phytosanitary issues (CIDA 2003, CGIAR 2005, FAO 2003, GFAR 2000, International Agriculture Assessment 2003, World Bank 2003, Bathrick 2001, and SPARE Subsector Review on Aquaculture 2003). The need for improving food quality and safety is relevant both to improve opportunities for marketing and trade, as well as to ensure the health of consumers. Food safety and quality issues are currently a topic of work in several CRSPs (Bean/Cowpea, Peanut, INTSORMIL). Food safety issues are also discussed with respect to the development of genetically modified organisms (IADB 1999, UN 2005a).

Specific research topics include:

- Reducing costs in developing countries for meeting the health, sanitary, phytosanitary, and traceability requirements for exports of food and farm products to the markets of developed countries (GFAR 2002).

- Development of techniques for safety protocols and improvement of quality standards (UC Davis, et al. 2005 May draft, NEPAD/CAADP 2003).

- Developing science-based standards for trade in food and agricultural products and inputs, including providing support to develop animal, plant, and human health measures based on international standards and sound science (US World Food Summit 2002); Supporting smaller producers' abilities to meet those standards (UN 2005a).

- Research of implementation of food safety practices (AAPARI 2002).

- Food safety conditions such as aflatoxin (AAPARI 2002, Peanut CRSP 2004); control of transboundary pests and diseases (NEPAD/CAADP 2003).

(2) TECHNOLOGIES THAT PROVIDE NEW GROWTH OPPORTUNITIES

Enhancing Genetic Improvement

A continuing need for crop genetic improvement of staple crops is found throughout the priorities literature, with most specific applications being regional. Improvement through conventional breeding is the predominant means by which most crops in the developing world continue to be improved and it ranks high among nearly all regional priorities. Most advanced programs use molecular techniques such as marker-assisted selection. This procedure uses molecular-level markers which can be identified by rapid, high-throughput analysis at reasonable cost. Marker use is especially helpful in identifying hard-to-measure traits such as drought tolerance and many disease and insect resistances during the breeding and selection process. Similar molecular techniques are being used to track mutations in both plant and animal pathogens to predict new outbreaks and the need to change resistance. The genetic improvement programs in every part of the world continue to place emphasis on needs in these areas, with the more advanced programs of Asia and Latin America commonly using advanced techniques for improving crop stress tolerance, and increasingly in nutritional quality enhancement. Programs in Africa and CWANA place such capacity high in priority.

Identified research topics include:

- Continually advancing the yield potential. In the densely populated regions, economic pressure on land and water resources is increasing at a sometimes exponential rate. As food demand continues to grow (FAO 2003), yields will have to increase above and beyond what is possible through reduction of biotic stress. Ongoing basic research to enhance potential is critical (IRRI/CIMMYT 2002, IFPRI 2004).

- Maintenance breeding of the staple cereals, oilseeds, pulses, and tuber crops. This is necessitated by the ever-changing pest and pathogen populations. In some geographical areas, and for some species, the private sector is increasingly meeting the need. In others, private sector investment is still low and NARS programs are struggling. Some of the staple crops for the poor, especially roots and tubers and others in less-favorable areas (mountainous, dry areas) receive inadequate research support (IADB 1999, CORAF/WECARD 2004, Hazell et al. 2001, NEPAD/CAADP 2003, UN 2005a, InterAcademy Council 2004).

- Breeding for specific traits of regional significance such as striga resistance in African sorghum (INTSORMIL 2004, CORAF/WECARD 2004).

- Breeding for both food quality and for animal feed quality of the stover in multipurpose crops and varieties (APAARI 2001, Campbell et al. 2004, UN 2005a). There is a growing awareness of the new

potential for nutritional enhancement using marker technologies, and for eventually being able to extend improvement widely through inclusion in parental lines through molecular techniques. This interest is growing in several regions (IFPRI/CIAT 2002).

- Molecular tools for diagnostics of plant and animal diseases and to assist the tracking of pathogen races (CORAF/WECARD 2004).

Biotechnology-Specific Research Needs

Biotechnology is of global research perspective because of its newness as a breakthrough science and having several dimensions of global significance and impact. More and more crops are now undergoing improvement for simply-inherited traits such as herbicide tolerance and narrowly-focused insect resistance using molecular transformations based on genetic engineering. This will become more common as biosafety standards and policies are put in place in developing countries. Several of the global priority documents and at least some for every region indicated the need for access to the above five general areas. In particular, biosafety for both humans and the environment was near the top in priority, with biocontainment needs often mentioned. The United States is regarded as the world authority in this area, but other countries clearly understand that their systems must be tailored to meet their own environments, needs, and capacities. Every region specified development and operation of national standards as a prerequisite to local adoption as well as meeting international marketplace standards. Nearly all of the regional documents reviewed reflected an understanding that their countries must have access to the many biotechnology tools and products as a prerequisite to continued advances in crop and animal productivity and safety. Few nations, let alone the smaller NARS, will be self-reliant in all necessary aspects of biotechnology. Much of the capacity will reside in regional centers of excellence, while other portions will be serviced from global "platforms." The handling of intellectual property (IP) issues will be critical to the design of those centers and platforms. Reasonable-cost technology access, particularly for minor crops and NARS in smaller countries will be a determinant. Maintaining broad diversity in the seed industry will also be highly dependent on that access.

Each of the global dimensions of biotechnology has continuing need for programming and funding (InterAcademy Council 2004). At the same time, each dimension below has regional and local relevance.

Identified research topics include:

- Gene search across genera and species for genes of particular interest and focus (including drought tolerance, and nutrient density and availability. A host of other traits for biotic and abiotic stress tolerance and for food quality are expected to follow). This is of significance because of synteny, a characteristic of genetic sequences that enables similar expression of DNA sequences when inserted into many crop species, making possible the creation of "genomic platforms" which can be used eventually by breeders of many crops (CGIAR 2005, IRRI/CIMMYT 2002).

- Description and sequencing of the target genes and their promoters along with markers to assist in downstream breeding efforts. This will remain one of the key services that advanced laboratories (whether global in service or regional) will provide for the foreseeable future to breeders in developing countries (IFPRI/CIAT 2002).

- Specific priority trait inclusion in widely-available parental material for use by local breeders. This will be an "intermediate service for placing the desired traits into appropriate crop background and parental materials for direct use by plant breeders who then use conventional crossing and selection techniques, usually with marker-assisted selection." (AARINENA 2000, Campbell et al. 2004).

- Vaccine development for animals (UN 2005c, CGIAR 2005).

- Bioinformatics to assist molecular work at all levels (APAARI 2002).

- Biosafety policy, standards, and procedures (all programs and regions). Most documents reviewed spoke to this issue whenever biotechnology was included.

- Training (human resource development) in bench science as well as in intellectual property, biosafety, and public education (United States 2002, all regional and most global programs).

Developing Integrated Production Systems for Enhanced Productivity/Sustainable Agriculture

The documents reviewed are interwoven with the buzzwords "integrated systems" which are given priority near the top in most lists. The phrase "sustainable agriculture" is often used interchangeably with "integrated systems." There are widely varying opinions about integrated production systems within USAID, BIFAD, and between United States practitioners and scientists and those in much of the developing world. In all the documents "sustainable" was used interchangeably with "highly integrated." In some uses it meant biologically integrated for biological and bio-geophysical processes, and in others the more holistic economic and social integration and interaction was included (IAR4D 2004, FARA 2002). None of the documents listed "sustainable agriculture" as a stand-alone research category. The definition of agriculture adopted by the US Congress (Title XVI, Subtitle A, Section 1603 as cited in the SPARE Recommendations to BIFAD) (SPARE 2003: 5) is:

> *An integrated system of plant and animal production practices having a site-specific application that will, over the long-term: satisfy human food and fiber needs; enhance environmental quality and the natural resource base upon which the agriculture economy depends; make the most efficient use of non-renewable resources and integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm/ranch operations; and enhance the quality of life for farmers/ranchers and society as a whole.*[26]
>
> *Many global and all regional priorities call for integrated approaches to fertility management, to pest management, and to water and land resource use. The current analysis uses the Congressional definition of sustainable agriculture without change in wording or intent as being consistent with the strong emphasis on systems integration in the documents, and particularly for CWANA and SSA.*

There are two approaches to achieve this objective found in the priority documents reviewed, and within the USAID-funded CRSPs. The SANREM CRSP (SANREM 2004) focuses on highly integrated systems to optimize productivity within given resource endowments, using IPM, cover crops and other crop and animal diversity options to simultaneously minimize adverse environmental impact while providing a multifunctional production system. This is the "sustainable agriculture" approach. It is completely consistent with the FARA-described IAR4D approach (FARA 2004) that is widely known and cited within the SSA region. The second approach is to focus research on more fundamental improvements in a single commodity or limited set of commodities, then integrate them into their growing environments. The end result may be very similar, but starts from different perspectives. Animal scientists, for instance, use the latter approach (Global Livestock CRSP 2004/2005).

Every priority-setting document at the global level that spoke to issues of productivity and certainly every regional document called for emphasis on integrated production systems (the long bibliography will not be repeated here). Many included the dimensions of natural resources management (NRM, INRM) in the same discussion. "Integration" can be limited to geophysical factors, to biogeophysical (an ecosystem – "narrowly" defined), or can include the "domains" of INRM as being social, political, economic, and biogeophysical (a production ecosystem, broadly defined). The documents were not specific as to which level of integration they refer to, but most are striving to integrate at the highest level possible, reducing specific systems to integration at the level of key "drivers" or "entry (impact) points."[27] Important elements include: a participatory approach, process-level science (usually with modeling) for key "drivers" of the production system, vertical institutional integration, and enhanced technologies for key production elements.

Identified research topics include:

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[26] For a detailed discussion of the scientific basis for highly integrated systems the reader is referred to Buck et al. 2004.

[27] For an excellent discussion of this most highly integrated approach see FARA 2004.

- **Information systems (GIS) technology for integration of key production-influencing gradients** (FARA 2004, Belaid et al. 2003). This enhances the ability to integrate variables and to extrapolate from a limited set of benchmark data points to extended areas.

- **Production systems for major commodities, with emphasis on resource-limiting environments** (IAC 2004, CAADP 2003, Johnson et al. 2004, UN 2005a, ICARDA/World Bank 2003, SPAAR/FARA 2000)

- **Animal production systems.** Examples include: Small ruminant systems of the CWANA area with pasture management, and feed supplements (ICARDA 2003, AARINENA 2000). Stabilizing the rapidly changing semi-nomadic systems of SSA as migratory corridors narrow and crop-livestock integration becomes more prevalent. Animal nutrition and health are priority factors (Global Livestock CRSP 2004/2005, APAARI 2002, IICA 2004), with market development important in all regions (Delgado et al. 1999). Research on livestock and livestock policies is also identified by the InterAcademy Council (2004).

- **Fisheries and aquaculture.** These are priorities for several regions (APAARI 2002, InterAcademy Council 2004, CAADP 2003, PD/A CRSP 2003) with fisheries continuing a slow decline, and aquaculture projected to continue its rapid growth (FAO 2002), with significant implications for ecosystem health (Reid et al. 2005). Environmental management both in terms of adequate water quality for production as well as nutrient loading control is critical (Reid et al. 2005). Community organization, developing human capital and trade and marketing systems all interact (Costa-Pierce et al. 2003). Cold chain linkages are being developed in parts of Asia.

- **Integrated forest systems** for multiple purpose use and for support of surrounding communities and forest dwellers (APAARI 2002, UN 2005b, Reid et al. 2005).

- **High value (primarily horticultural) systems.** These are of high priority and mentioned in every single region (APAARI 2002, IICA 2004, ICARDA/World Bank 2003, FARA 2004). Most see these as specialty, niche market outputs of growing local and regional market potential. Market linkages to local and regional retailers, including access to supermarket and international markets and post-harvest and processing technologies are all widely reported as needs. These products are increasingly seen as ways of diversifying production systems with modest potential for income generation for small farmers in the face of declining prices of major commodities and growing demand.

- **Integrated pest management.** This is included in most regions, coupled with need for information technologies. Ecosystem approaches, coupled with biotechnology applications are seen to provide significant stimulus. Environmental demands on more and more heavily populated landscapes with demands for clean water are driving demand. Breakthroughs such as whitefly control in cassava in Africa and the successes with intensive rice production in Asia all create interest and generate support (World Bank 2002, InterAcademy Council 2004, IPM CRSP Annual Report 2004).

- **Integrated soil quality, fertility, and land degradation.** In most of Africa soil deterioration is a primary limiting factor in achieving crop and animal productivity and carrying capacity. Similar effects have been seen in South Asia, Latin America and the CWANA region as cropping intensity has increased. A vicious cycle of loss of soil organic matter, the intensification of cropping systems with loss of crop diversity, overgrazing of rangelands, reduced water infiltration leading to increased water runoff, loss of soil through erosion and highly inefficient markets for fertilizer input are proving disastrous. Integrated approaches to soil quality improvement including reduced and appropriate tillage, use of selected crop diversity, use of local organic resources, and judicious insertion of fertilizer nutrients in an integrated fertility system have proven highly effective in both Africa and Asia (FARA 2004 Volume II, APAARI 2002). The crucial element for success is an integrated approach to attack root causes. A critical factor mentioned often is to improve efficiency of fertilizer markets.

(3) POLICIES, INSTITUTIONS AND TECHNOLOGIES THAT SUSTAIN THE NATURAL RESOURCE BASE (NRM)

Conserving, Protecting, and Characterizing Genetic Biodiversity

Scientific breakthroughs in genetic characterization through molecular marker techniques have made it possible to target populations for conservation based on genetic diversity. Significant (and predictable) portions of the populations can be programmed for ex-situ or in-situ conservation, making efforts much more effective and efficient than the phenotype-driven collection and preservation processes of the past. Animal and fish populations, for instance, are now much more economically feasible to protect. Genetic information systems make the material more widely accessible. Science is rapidly moving toward the provision of gene sequences for specific traits to be available in "libraries" for use in target species by other laboratories. Many priority listings for conservation work are for assistance in either developing or accessing these materials. In summary, the total list of integrated production systems and natural resources management categories derived primarily from regional prioritization sources parallels the framework outlined in the UN Millennium Environmental Summary (UN 2005b).

Identified research areas include:

- Continued collection of the major staples, particularly from high environmental stress areas, with screening for genes for tolerance (CGIAR 2005, CORAF/WECARD 2004).
- Collection of selected high value crop species (CGIAR 2005).
- Marker-assisted characterization of native livestock breeds (CORAF/WECARD 2004) with planned programs for in-vivo and cryo-preservation (CGIAR 2005).
- Fish population characterization (CGIAR 2005, Costa-Pierce 2003).
- Production ecosystem management in key centers of plant origin for protection of diversity (NEPAD/CAADP 2003) of crops and of the microbial and mesofaunal diversity associated with them (CGIAR 2005).
- Documentation and conservation of indigenous horticultural crops (UC Davis et al. 2005 May draft).

Water Management

Natural resources management is obviously a key part of the integrated production systems, above, but includes additional dimensions and is approached from a different perspective. NRM-focused projects are usually directed toward key environmental problem areas (animal, crop, or forestry systems). Soil loss or deterioration may be a primary focus. When combined with water scarcity, these areas rise to top priority, as in the CWANA region (World Bank 2003). Nearly every global prioritization and every regional listing place water resources management either at or near the top (UN 2005b). In Asia, growing population pressure and increased economic activity are putting severe strain on fresh water resources. Regional priorities reflect these concerns (APAARI 2001). In Sub-Saharan Africa, there is a resurgence of interest in improving irrigation schemes to reduce the dependence on rainfall (CAADP 2003). Research priorities cover activity from trans-boundary issues, to river basin, watershed, local community, and on-farm applications. The framework has been adapted from IWMI (2002) and reflects the several dimensions found in both global and regional priorities.

Identified research topics include:

- Global and national water systems (to include globalization, trade and macroeconomic policies, investing and financing, and trans-boundary issues).

- Integrated basin water management systems (to include upstream-downstream interactions, sustainable and equitable exploitation of the water resource, urban-rural interfaces, and food production vs. ecosystem issues).
- Aquatic ecosystems and fisheries (to include policies and governance, valuation of ecosystem goods and services, and improved water productivity).
- Multiple use of upper catchments (to include community organization for water use, income, risk management, and improved land and water resource management).
- Crop water productivity improvement (at the plant, crop and field, and ecosystem levels).

Coastal Zone Management

Development issues for coastal zones closely parallels the framework for river basin and watershed management. The policy arena, the sources of pollutants which include outflow from huge coastal urban centers, the difficulty of controlling and managing access and use of a marine resource, the competing demands for its services, and the common lack of political voice of artisan fishers are challenging sets of issues. GIS data sets, coupled with increased capacity for documentation of water quality and pollutant loading of the ecosystem are beginning to provide quantitative monitoring and trend information which can be used to inform policy and investment both in research and in remedial action.

Climate Change and Global Warming

Climate change research recommendations occur as expected in global assessments, and at the regional level for research on response to expected climatic changes in their production environments (UN 2005b, ICARDA/World Bank 2003).

(4) POLICIES AND INSTITUTIONS THAT ENABLE GROWTH AND NATURAL RESOURCES MANAGEMENT TO BE PRO-POOR

Expanding Access to Markets and Strengthening Value Chains

There is strong consensus among all the global and regional priority documents about the fundamental importance of improving market access and operation, opening up national, regional, and international trade, and supporting greater competitiveness (UN 2005a, IFAD 2001, World Bank 2003, USAID 2004). The importance of "linking producers to markets" is the organizing theme and title of the USAID agricultural strategy, and emerges as the top priority of the preliminary report of the USAID-funded horticulture assessment (UC Davis et al. 2005 May draft). Both US and other donors as well as national governments have shifted from a belief that markets could, independent of policy change and public sector involvement, transform rural sector economies supporting agriculture, entrepreneurial development, and environmental sustainability (Omamo et al. 2004 [ASARECA], USAID 2004, Commission on Africa 2005). The InterAcademy Council report on African agriculture states, "the smaller the farm, the greater is the need for marketable surplus and thereby cash income that is essential for sustainable nutrition security" (2004). CIDA similarly supports promoting the access of farmers in developing countries to international markets as one of its five key strategy themes (CIDA 2003).

Supporting rural producers, processors, and suppliers from the field to the (super)market shelf is the premise of a value chain (also referred to as market chain or commodity chain) approach. It encompasses not only more nuanced analysis of what are the most appropriate crops for producers to produce (e.g., high value horticultural crops and other non-traditional products, including natural collected products, livestock, dairy, and fish) (CGIAR 2005, InterAcademy Council 2004, Bean/Cowpea CRSP 2004, Peanut CRSP 2004, INTSORMIL CRSP 2004), but also considers processing cold storage, and packaging options in support of production. Support to transform extension systems (including private sector systems and participatory extension (InterAcademy Council 2004, Commission on Africa 2005)) and NARS to provide technical packages for new crops and processing, storage (especially reduction of post-harvest losses (CIDA 2003,

DFID 2005), and shipping solutions are components of many programs (SPAAR/FARA 2000, AARINENA 2000, IFPRI 2004).

Identified research topics include:

- Analyzing constraints to access market information (UC Davis et al. 2005 May draft).
- Developing better methodologies for communicating price and quality information to participants in the value chain (UC Davis et al. 2005 May draft).
- New technologies for reducing post-harvest losses (CIDA 2003, DFID 2005).
- Better understanding of the role of production for different markets (DFID 2005).
- Promoting diversified and sustainable production systems for expanding markets (DFID 2005a).
- Availability of international and domestic markets for the poor and links to rural poverty; improved access to financial capital and markets (IFAD 2001, African Development Bank 2002); making international and domestic markets work for the poor (Priority Area 5 CGIAR 2005).
- Markets for inputs and services (World Bank) and strengthening of farmer-to-market linkages (UC Davis et al. 2005 May draft).
- Promote and engage climate-friendly carbon and technology markets (UN 2005b).
- Gender issues in the horticultural value chain (UC Davis et al. 2005 May draft).
- Research on the future of extension systems (InterAcademy Council 2004).

Resource Access and Tenure Security

Many key documents assert that the larger goal of improving agricultural productivity and environmental sustainability is to (1) improve social well-being, broadly understood; (2) reduce poverty and hunger, and (3) improve health and nutrition, and conserve natural resources (e.g., GFAR, IFAD 2001, EIARD 2004, IAAST 2004, World Bank 2002, UN 2005a, UN 2005b, UN 2005c). When access to assets (such as land, water, and finance) is unequal, it often reflects intractable patterns of inequality that constrains agricultural productivity, sustainable resource management, and limits opportunities for income generation (DFID 2005, IFAD 2001). Identifying ways to improve rural inhabitants' access to productive assets has become a core component of many donor programs.

Identified research topics include:

- Investigating socio-economic perspectives on risk and vulnerability (DFID 2005, GL CRSP [2004, 2005], IPM CRSP 2004, BASIS 2004).
- Investigating regulatory rules and procedures, property rights and judicial procedures for institutional reform of rural and agricultural development banks (US 2002, World Food Summit 1998).
- Innovating the development of micro-finance products (savings, insurance), business development services, and lending techniques that can help poor individuals, especially women, to better manage risks and their vulnerability to external shocks (US 2002, World Food Summit 1998).
- Bargaining processes to be used by rural producers to gain access to resources (African Development Bank 2002).
- Research into tenure systems (BASIS CRSP 2004, NEPAD/CAADP 2003, UN 2005a).

Rural Finance

The popularity of rural finance programs declined during the 1980s, when implementation of these programs had very mixed results (DFID, USAID 2004). Programs were overly dependent on external sources of funding, and policies were put in place that proved to be unsuccessful. Government-managed activities were expensive and inefficient (USAID 2004: 5). While there is wide agreement that rural financing can stimulate rural enterprises, there is not a similar agreement about what such a system might look like. With the move towards higher-value products (horticultural, livestock, dairy), some financing services are being provided through private sector input suppliers and/or processors and wholesalers, as well as by the expansion of rural producer groups. Significant research has been done on types of rural finance such as microfinance, of which agricultural finance is a sub-set. Emerging areas for research include insurance programs, information technologies, and building of market linkages with the participation of financial institutions, and word on credit programs (African Development Bank 2002, USAID 2004, BASIS CRSP 2004). The CGIAR Science Council identifies rural institutions, including the operation of rural financing, as one of its five central research themes (CGIAR 2005).

Social Inclusion and Participatory Approaches

Increasing the quality and extent of producer participation in agricultural and NRM research is a strong theme, along with the role of civil society organizations more generally (CGIAR 2005, DFID 2005, EIARD 2004, World Bank 2003, GFAR, IFAD 2001). DFID (2005) makes it one of three core components, identifying it as working alongside poor farmers to identify and tackle agricultural problems such as restricted access to markets, livestock or post-harvest crop losses, or poor seed. The European Commission lists producer participation as one of among its five principles in identifying research problems. Several documents note the need to better understand and utilize indigenous knowledge along with formal science as a means to enhancing productivity and creating sustainable systems, particularly in Africa (UN 2005b, IAC 2004, SPAAR/FARA 2000, Belaid et al. 2003, World Bank 2003, GFAR).

Identified research topics include:

- Exploration of indigenous knowledge in Africa (IAC 2004).
- Identifying mechanisms to improve participatory research, participatory assessments, and beneficiary participation (CGIAR 2005, IPM CRSP 2004, IFAD 2001, NEPAD/CAADP 2003, CIDA 2003).

Integrating Gender/Enhancing Gender Equality

There is growing recognition of the importance of incorporating gender issues into agricultural and NRM programs. Several donors emphasize gender equality as a primary focus. The CIDA rural development strategy identifies the achievement of gender equality as one of its five core themes (CIDA 2003). Gender is identified as a significant cross-cutting issue for DFID, IFAD (2001), the World Food Summit Plan of Action (1998), the World Bank (2002); it is included in the UN Millennium Task Force reports (2005), as well as in the Internal Agricultural Assessment cosponsored by several donors. Gender issues also appear as a strong concern of several regional documents (discussed below) and of stakeholders, more generally (GFAR 2000).

Identified research topics include:

- Investigating agricultural implements and tools for women (IAC 2004:93).
- Developing labor-saving technologies to reduce women's work (IAC 2004: 94).
- Improving the national capacity to use and to improve the quality of gender analysis (CIDA 2003).
- Investigating the gender aspects of current and future technologies (International Ag Assessment 2003).
- Investigating effective methods to reduce gender inequality (IFAD 2001).
- Integrating gender issues into research planning and implementation (World Food Summit 1998).

Health Concerns Including Improving Nutrition

The need to employ agricultural research and development (ARD) to address health and nutrition needs is highlighted by the European Commission (EIARD 2004), the International Agriculture Assessment proposal (2003), IFAD (2001), and the World Bank (2003), including suggestions to improve the nutritional quality of selected crops (including biofortification) (CGIAR 2005 and CGIAR Challenge Program on Nutrition, IFPRI 2004). CIDA (2003) notes the importance of nutrition education as a tool to improve food security. Several USAID CRSP programs see this link between agriculture and health/nutrition as an important component of their current work (e.g., Global Livestock's work on animal source foods and children's health, the Peanut CRSP's work on aflatoxin, the Bean/Cowpea and INTSORMIL work on enhancing the nutritional quality of staple crops and their processed products) (CRSP Annual Reports).

Identified research topics include:

- Biofortification.
- Consequences of the use of animal source foods (GL CRSP 2004) and fish to improve human nutrition (Costa-Pierce 2003).
- Improving the database and analysis of food and nutrition security (IAD 2004).
- Linking agricultural and nutrition extension (UN 2005a).

Addressing HIV/AIDS

Particularly in Africa, the interconnectedness of HIV/AIDS and agricultural productivity is strong and mentioned as a development concern. SSA is home to 75 percent of the total global population of people living with HIV/AIDS, some 25 million people. The HIV/AIDS epidemic poses an enormous strain on social and economic development and has impacted agricultural productivity in multiple arenas. On the farm, the impact of HIV/AIDS is felt in reducing available labor and resources and it is generally those in their most productive years who are affected. Women are doubly burdened by an increase in the need for their productive labor to replace those who are ill as well as provide care to those who have been stricken with the disease. Agricultural research institutions and extension systems have been seriously affected by loss of personnel through sickness and death. At the same time, adequate and nutritious food has been shown to reduce the rate at which the disease worsens and is an important factor in the effectiveness of medication. The NEPAD/CAADP (2003) report notes that HIV/AIDS is "rapidly decimating the age groups with the most potential for technologically upgrading agriculture."

Identified research topics include:

- Mitigating impact of HIV/AIDS on agricultural production and NRM practices (IFAD 2001, World Bank, NEPAD/CAADP 2003).
- Impact of HIV/AIDS on extension and research capacity.
- Linking of nutrition, food security, and the progression rate of HIV/AIDS and other diseases (USAID Agricultural Strategy 2004).
- Using extension services to promote HIV/AIDS prevention messages (USAID Agricultural Strategy 2004).
- Investigation of the impact of the pandemic on intergenerational knowledge transfer (NEPAD/CAADP 2003).

REGIONAL RESEARCH THEMES

The respective regions have very different resources and needs. This summary focuses on priorities for international research input for the regions, considering differences in national research capacity and private sector technology inputs. Many of the topics in the "clustered" research themes above (such as biotechnology) have significant applications at the regional level, but not all of these applications have been repeated unless specifically mentioned within the priority development/research areas identified within a given region.

ASIA

Asia has achieved a dramatic technological and economic transformation in recent years. But it still has the largest number of hungry people, and serious problems remain, particularly in maintaining past progress, promoting continuing agricultural transformation, and extending it to the rural populations.

Four priority development/research areas stand out:

Water use/on-farm water management. FAO notes that water resources will be a major factor constraining economic growth in South Asia. South Asia will be using 41 percent of its renewable freshwater resources by 2030 and will need to achieve greater efficiency in water use (FAO 2003). The rain-fed arid, semi-arid, and humid ecosystems of South Asia are risk-prone production systems with rapid degradation of land and water resources. Similarly, irrigated sub-tropic ecosystems face degradation of land and depletion of groundwater, threatening their sustainability. Natural resources management with a focus on conservation of management of soil and water was one of four major priority areas for East and Southeast Asia (APAARI). The World Bank is focusing on projects that will enhance productivity and create non-farm employment such as water management schemes in East Asia and the Pacific and projects fostering efficient, sustainable, and equitable use of water resources in South Asia (World Bank).

Important research topics include:[28]

- GIS-assisted mapping of NRM degradation areas and their intersection with poverty.
- Watershed and river basin level water management (and partitioning) science and its ability to inform policy and water use planning.
- Soil and water management for on-farm efficiency (including the science of reduced tillage, which is taking hold in the sub-tropics of South Asia).
- An integrated natural resources management (INRM) approach that includes crop selection and crop management to cope with declining water resources.
- Research on and demonstration of reduced tillage for cost effectiveness and improved water infiltration.
- Genetic enhancement of crops for drought and salinity tolerance (including through biotechnology).

Income diversification through high-value commodities (HVCs). Due to rising income and urbanization, diets are diversifying and demand is growing rapidly among all income levels for HVCs — fruits and vegetables, milk, poultry, and fish (FAO 2003). Small farmers can often supplement a cash income with HVCs targeted toward local niche or more general specialty markets. The World Bank's new strategy notes a change in smallholder production emphasis from staple commodities to HVCs (World Bank). The World Bank identifies priorities for projects that enhance productivity and create non-farm employment such as storage and processing facilities for agribusiness in East Asia and Pacific and facilitating rural and non-farm

[28] The specific research topics were taken primarily from the APAARI regional consultations. Emphasis is also placed by APAARI on crop genetic improvement for resistance to pests and diseases, where national programs and the private sector have considerable capacity. Genetic improvement for nutritional value is of high priority, but national capacity is modest. Animal pathogenesis and epidemiology is of significant concern, and not being well addressed.

competitiveness in South Asia. APAARI gives cereals first priority, livestock second priority, and horticulture third priority among commodities in South Asia and livestock first priority, cereals second priority, and fruits and vegetables third priority in West Asia (APAARI). These reports urge diversification towards livestock and horticultural crops, and market integration as major opportunities.

Important research topics relating to HVCs include:

- Enhancing trade policy and domestic policies.
- Enhancing genetic capacity including through biotechnology.
- Integrating production systems for enhanced productivity/sustainable agriculture, IPM, integrated soil fertility, water use/farm level management.
- Increasing value chains (including post harvest/processing), food safety, quality, and green-labeling protocols.

Staple foods in less-favored areas. Many of the poor live in less-favored areas of lower water availability, poor soils, steep slopes, or other constraints to high productivity, and are often subject to high uncertainty and production risk. Their diets are still high in staple commodities. IFAD (2001) lists enhancing the productivity of staple food in less favored areas as one of its four priority areas. APAARI lists cereals as first priority in South Asia and second priority in West Asia (APAARI). Important research topics include:

- Enhancing genetic capacity (yield capacity and biotic/abiotic stress tolerance, including through biotechnology).
- Integrating production systems for enhanced productivity/sustainable agriculture, IPM, integrated soil fertility, water use/farm level management, and conservation of natural resources.
- Characterization and use of genetic resources (e.g., for improved drought or disease resistance or to introduce other desired plant attributes).

Natural Resources Management (NRM). APAARI notes the multi-faceted and inter-connected nature of regional issues of food security, loss of biodiversity, widespread poverty, and unsustainable extraction of natural resources in East and Southeast Asia (APAARI). The World Bank lists supporting natural resources management as a priority in both the East Asia and Pacific and the South Asia regions (World Bank).

Important research topics include:

- River basin/watershed issues and management.
- Land degradation.
- Sustainable forest systems, including the goods and services provided to forest dwellers.
- Coastal zone management, ecosystem biodiversity.
- Social inclusion/participatory approaches (IFAD is particularly strong on the latter).

LATIN AMERICA AND THE CARIBBEAN

There is a marked inequality in the distribution of land in Latin America and the Caribbean, wealth and income. This region is also highly vulnerable to exogenous factors, for example, globalization and natural disasters. Marketing costs and channels are often vulnerable, and production often variable, reducing market competitiveness. The largest group within the rural poor is indigenous people, followed by small farmers and subsistence and landless laborers. These groups are concentrated on mountain slopes in subtropical zones

and arid and semi-arid plateaus; humid and semi-arid tropics; sub-tropical valleys; and coastal plains. Three priority development/research areas stand out.

Competition in/access to domestic and international markets, particularly by the poor. While the supermarket phenomenon is sweeping Latin America, the poor are having difficulty benefiting. Although Latin America has a natural off-season export market for HVCs to the US, the poor have difficulty benefiting. The World Bank lists trade and competition in markets as two of its top priorities (World Bank). IFAD lists increasing competitiveness and globalization of markets as one of its top priorities. Development of markets for services relevant to the rural poor and access to dynamic regional and international markets are two of its five thematic areas of knowledge management (IFAD 2001). The Inter-American Development Bank lists two of its priorities as market information and export promotion and strengthening medium-sized business and organized producer groups to produce and export quality products (IADB).

Important research topics include:

- Developing new market instruments (risk management, futures markets, etc.).
- Solving market access problems for the poor — physical, political, and structural.
- Developing institutional arrangements to ensure that the poor benefit from rapidly emerging (super)markets and can meet requirements for quality, reliability of supply and health, safety, and ethical assurances.

Land and property rights; access to rural finance. IFAD lists promoting innovative rural financial services and improving access to land and property rights as two of its priorities (IFAD 2001). The Inter-American Development Bank lists developing financial and capital markets and risk management and developing land markets as two of its six priority investment areas (IADB).

Important research topics include:

- Enabling the poor to access legally secure entitlements to assets—land, water, credit, information, and technology—to better enable them to invest in land management.
- Designing financial services for the poor focusing on risk and vulnerability.

Sustainable natural resources. The World Bank lists sustainable management of natural resources as a regional priority (World Bank). The Inter-American Development Bank lists sustainable use of natural resources, including conservation and rational use of natural resources, more efficient use of water resources, and integrated watershed management, as one of its priorities (IADB).

Important research topics include:[29]

- Cropping, cover crop, and soil management practices, including reduced tillage for sloping lands which are heavily populated by poor people.
- Enhanced systems for food security of poor people on marginal lands.
- Policy and protocol development for "green" labeling and for ecosystem payments to encourage sustainable productivity and land use.
- Enhancing the role of civil society and NGOs such as CONDESAN in NRM, especially in the mountainous areas.

[29] IICA, 2004

CENTRAL AND WEST ASIA AND NORTH AFRICA

The World Bank's Cairo consultation for the CWANA region notes that the region is facing a number of converging trends that threaten the future livelihoods and the poorest sector of society — including water scarcity, land degradation (as much as 45 percent of the total land area dedicated to agriculture and rangeland is experiencing some form of land degradation), and global climate change (CWANA).

Water use/farm level management. FAO notes that water resources will be a major factor constraining expansion in the North Africa/Near East region, which will be using 58 percent of its renewable fresh-water resources by 2030. The region will need to achieve greater technical and economic efficiency in water use (FAO 2003). The World Bank states flatly that water availability is crucial to all agricultural systems; water variability, and thus, vulnerability, varies significant across production systems. Rationalizing water management and policies is one of its three priorities for the region (World Bank 2003). IFAD states that water is the single most critical constraint on the rural poor (IFAD 2001). The World Bank consultation for the CWANA region states that the region is one of the most water scarce in the world and this technical scarcity is predicted to worsen markedly over the next 25 years.

Important research topics include:[30]

- GIS-assisted water resource quantification and modeling from river basin to sub-regional and watershed data, including groundwater resources to inform policy on allocation and to assist in trans-boundary discussions.
- Water demand options.
- Integrated approaches to water management, urgently needed to consider water demand management, and water use efficiency of different production systems.
- Water resource allocation and policy packages.
- Development of drought and salinity tolerant plants by both conventional breeding methods and new biotechnologies.
- More efficient irrigation systems.
- Institutional development, focusing on community-based water user associations

Crop improvement for both major commodities and high value crops. The World Bank Consultation (ICARDA 2003) the AARINENA priority processes (AARINENA 2000) and the ICAR sub-regional consultation (Campbell et al. 2004) all give number two priority to the improvement of staple and high value crops for the region. Wheat and barley, along with chickpeas, lentils and other pulses are the primary food staples for much of the area. Potatoes are common in the hilly areas of Central Asia. Each of these crops needs improvement for drought tolerance and several for disease resistance. National programs to deal with these issues are growing in capacity. However, in many instances, the resources and trained scientists will not be adequate to solve these problems without ongoing assistance.

Important research topics include:

- Improvement of winter wheat, barley, maize, with resistance to the major pathogens of the area, such as resistance to yellow rust.
- Drought tolerance (including through biotechnology approaches).

[30] The specific research topics above were taken from the following priority-setting consultation documents, with most of the specific areas being common to several of the documents: AARINENA 2000, World Bank 2003, ICARDA 2003 (World Bank, Cairo), Belaid et al. 2003, and Campbell et al. 2004.

- Earliness and shorter maturity for many crops.
- Seed certification programs, including early generation, foundation seed programs.

Income diversification. The World Bank identifies facilitating agricultural growth and competitiveness as one of its three priorities (World Bank 2003). IFAD identifies income diversification as one of its four priorities (IFAD 2001). The World Bank CWANA consultation states that *per se*, rather than productivity, increased efforts to diversify production systems with new crops and rotations that are more conservative in water use should be the focus.

Important research topics include:

- Developing production systems for high value crops for regional and international markets.
- Developing post-harvest processing methods for value-added products of the region's crop and animal outputs.

Access to infrastructure and services. The World Bank identifies improving access to social and economic infrastructure as one of its three priorities (World Bank). IFAD identifies empowerment and gender as two of its four priorities (IFAD 2001).

Important research topics include:

- Improving access, particularly women's access, to social infrastructure including rural roads, rural water supply, rural electrification, and information technology.
- Improving exchange and sharing of knowledge, providing the end-user with appropriate knowledge including technological, financial, and marketing information, in order to help alleviate poverty.

Natural Resources Management. IFAD identifies natural resources management as one of its four priorities (IFAD 2001). The World Bank CWANA consultation identifies land degradation as one of the major problems hurting poorer people in the region (CWANA).

Important research topics include:

- Pasture management systems to maintain better crop cover and organic matter accumulation for the complex rangeland use patterns.
- Improved pasture species.
- Supplemental feed sources using alternative crops and residues to reduce grazing pressures.
- Reduced tillage research and demonstration efforts to reverse the heavy tillage practices.
- Community-based approaches to achieve the above.

SUB-SAHARAN AFRICA

This region has the highest proportion of poor in the world and the number of poor is expected to increase. There are also wide disparities in the performance of countries throughout the region. Agricultural production increased by about 40 percent between 1980 and 2001, while in Sub-Saharan Africa it fell by 5 percent (DFID). During the 1990s only 12 of the 48 countries were able to maintain agricultural growth rates of 4 percent or better (World Bank). About 100 million Africans, a fifth of the region's total population, live in countries immersed in civil or international conflict or unrest with sharply rising poverty (World Bank). Few of the countries of the region are projected to meet the Millennium Development Goals for economic growth and hunger (African Development Bank 2002). This pessimism notwithstanding, agriculture and sustainable resource management is presented in nearly all the reviewed documents as the means by which Sub-Saharan

Africa must address its problems of poverty and hunger. The NEPAD/CAADP report, for example, makes the statement starkly: "NEPAD believes that agriculture will provide the engine for growth in Africa" (2003: iii).

Several prerequisites for improvements in institutional and policy "enabling factors" to create a favorable environment for growth in agricultural systems must be addressed before agricultural research outputs will have impact beyond very low marginal improvements.

Governance

> *It is an underlying assumption that the creation of enabling conditions will go hand in hand with investment, otherwise it becomes an empty exercise, with little hope of success or of acceptance by Africa. Thus, for example, to a considerable degree due to lack of accompanying investment, the decades-long efforts at structural adjustment of African economies, policies, and institutions have shown few discernable benefits, except in isolated cases (NEPAD/CAADP 2003).*
>
> *Poor political and economic governance are twin root causes of much of the malaise that afflicts Africa. They create general political and economic uncertainty, an unpredictable environment for business, political unrest, and sometimes, even war that together make the pursuit of economic growth difficult. The issue of participation is also critical; IFAD observes for Western and Central Africa that "[F]irst and foremost, the poor have little or no voice in many major decision affecting their livelihoods."* [31]

The IFPRI 2020 consultations put strengthening governance and public accountability as top priorities (IFPRI 2004: 6). The World Bank lists making governments and institutions work better for the poor (decentralization, participation, voluntary producers' organizations) as one of their four priorities. Its major emphasis is on the institutional foundation for reducing poverty. It advocates support for government efforts to decentralize and enhance the participation of rural communities (World Bank). IFAD identifies strengthening the capacity of the rural poor and their organizations, and improving the pro-poor focus of rural development policies as two of their priorities for Western and Central Africa (IFAD 2001). The African Development Bank identifies inappropriate policy environment for agricultural investment and limited participation of end-users in policy articulation and formulation as two of the main "endogenous" constraints to African agriculture. The Commission for Africa also notes that governmental reform as a primary area for change would influence all sectors (2005).

Shocks (particularly HIV/AIDS and conflict). The World Bank identifies HIV/AIDS and conflicts as major reasons for under-performance in the region (World Bank). IFAD proposes to respond to major HIV/AIDS and conflict and post-conflict situations, as one of its major thrusts for Eastern and Southern Africa (IFAD 2001). The African Development Bank identifies persistent instability, wars, and civil unrest in some countries and the presence of endemic diseases such as malaria and HIV/AIDS as major "exogenous" factors inhibiting agricultural productivity in Africa (African Development Bank 2002). The IFPRI 2020 exercise calls for more effective management of vulnerability to shocks and identifies investing in pro-poor public health policies and actions, in particular the prevention, control, and management of HIV/AIDS, malaria, and tuberculosis as one of its five priority areas (IFPRI 2004).

Infrastructure. The African Development Bank identifies the poor state of basic infrastructure for delivery of social services and absence of good physical infrastructure as two of the main "exogenous" factors inhibiting agricultural productivity. Infrastructure (rural transport, water supply, and sanitation) is listed as one of the six instruments or "ins" that is required to stimulate the supply of output (African Development Bank). The World Bank lists infrastructure as one of its components for promoting widely-shared growth (World Bank). CAADP also states that "improvements in roads ….are vital to raising the competitiveness of local production … and will stimulate the volume of production and trade" (2005: 3). This problem of poor infrastructure—particularly rural roads, markets, and communications – is pervasive and described and addressed throughout the various agricultural development strategies.

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[31] http://www.ifad.org/operations/regional/2002/pa/pa/htm

If these problems can be successfully addressed, then agricultural research outputs will have impact in the following areas:

Markets. Improving market linkages and ensuring market access for small farmers is a fundamental target of development efforts in Africa. CAADP targets include two relating to markets: to promote dynamic agricultural markets within countries and regions and to link producers and processors to agricultural export markets (NEPAD/CAADP 2005: 2). IFAD identifies promoting efficient and equitable market linkages as one of its four priorities for Eastern and Southern Africa and improved access to markets as one of its four priorities for Western and Central Africa (IFAD 2001). The African Development Bank states that it is important to explore how globalization and markets impact the poor and what can be done to make markets (internal and external) and institutions work for the rural poor. With liberalization, it is necessary to support market intermediaries and promote competition, transparency, and market access, if the transition to unregulated markets of poor farmers is to be facilitated. One of the main "endogenous" constraints to African agriculture is high levels of post-harvest losses. Market liberalization and access that lead to higher producers' prices is listed as one of the six instruments or *"ins"* that are required to stimulate the supply of output. Related to this are inputs, institutions, infrastructure, and information – also aspects of markets (African Development Bank). The IFPRI 2020 consultation calls for open access to domestic, inter-regional, and international markets and trade. Investment in processing for more value-added addition and quality assurance in the supply chain of agricultural products is also listed (IFPRI). One of DFID's three key areas under "sustainable agriculture, especially in Africa" is participation: working with poor farmers to identify and tackle their key problems, which could include, for example, problems such as poor market access or post-harvest losses (DFID). The UK Commission on Africa urged that support be given to African national and regional markets (UK Commission on Africa). The InterAcademy Council Panel on Agricultural Productivity in Africa (2004) recommended enhancing the role of markets and policies to raise the income of the poor and increase food security.

Important research topics include:

- Making staple food markets work better for the poor.
- High value commodity, production/processing technologies, to include market chains.
- Improving post-harvest and storage techniques.

Water and Soil Technology and Practices. The World Bank lists research and extension as one of its components for promoting widely-shared growth (World Bank). IFAD lists improving access to and management of land and water as one of its four priorities for Eastern and Southern Africa (IFAD 2001). The sustainability of agricultural productivity requires strong attention to environment and natural resources management, especially soils, watersheds, and biodiversity (IFPRI). One of the four DFID priorities is sustainable agriculture, especially in Africa (DFID). The UK Commission on Africa urged investments in irrigation since "irrigated land is more productive than land which relies on rain-fed agriculture" (UK Commission on Africa). The CAADP thrust to "extend the area under sustainable land management and water control systems" specifically calls for improved agricultural research that would contribute to increasing food supplies while sustainably managing natural resources.

Important research topics include:

- Improving soil quality and integrated fertility management (CAADP 2005: 3), combining crop (cover crop, tree) diversity with local sources and fertilizer inputs.
- Improving cultivation techniques that conserve soil and water.
- Improving water resources management, and improving techniques such as rainfall harvesting and drip irrigation (CAADP 2005: 3).

- Improving farm implements and use of mechanization to enhance labor productivity.

Crop and Animal Technology. IFAD (2001) lists raising agricultural and natural resource productivity and improving access to technology as one of its four priorities for Western and Central Africa. The African Development Bank lists inadequate adoption of available technology as one of the main "endogenous" constraints to African agriculture. Innovation or appropriate technology is listed as one of the six instruments or *ins* that are required to stimulate the supply of output (African Development Bank 2002). The IFPRI 2020 consultation lists investing in improved seeds and livestock that fit the agro-ecology and investing in a continent-wide effort to achieve sustained soil fertility as two of its three common top priorities for investing in agriculture. It argues for investing in raising agricultural productivity, especially among small farms (IFPRI). One of the four DFID priorities is sustainable agriculture, especially in Africa, with special attention to market access, technology, and public participation (DFID). The NEPAD/CAADP report lists adaptive management of appropriate germplasm as one of its four priority research themes (2003:17).

Important research topics include:

- High-yielding disease/pest tolerant varieties for crops grown in different kinds of marginal, rain-fed areas. The NEPAD/CAADP report specifically mentions cassava's contribution to both food security and income generation (2005: 5). The Inter-Academy Council report specifically recommends concentrating on four key African farming systems: maize-mixed system, cereal/root crop-mixed system, irrigated system, and tree crop-based system, of which maize, rice, sorghum, millet, legumes, cassava, yams, cocoa, coffee, cattle and goats are the most important crop and animal products. These four systems were identified as having the greatest productivity potential while also exhibiting high prevalence of malnutrition.

- Improving animal production systems, with integrated supplemental feed/pasture/crop and nutrient management.

- Systems which enable poor people to hear about and choose from appropriate technologies.

- Working with poor farmers to identify and tackle their key problems which could include, for example, inadequate seed varieties, or losses of up to 20 percent of livestock per year (DFID 2005).

- New technologies and practices such as new drugs and vaccines that improve the health status of poor people's lives.

- Enhancing resilience to climate change and potential mitigation measures.

Participatory study of socio-economic constraints. This topic was a key area adopted by the NEPAD Comprehensive Africa Agricultural Devleopment Programme in conjuction with the FAO Special Programme on Food Security. The need for better understanding of stakeholders' needs and perceived constraints through participatory research and participatory assessments is expected to provide input into the monitoring and evaluation of on-going activities and improve the formulation of new activities.

Without exception, the documents on African research and development highlighted the central role of women in African production, processing, and marketing systems, and most mentioned the importance of addressing the gender equality goals of the MDGs. While elsewhere, gender may be considered a cross-cutting issue, in Sub-Saharan Africa it is explicitly mentioned as a key development and research focus. The NEPAD/CAADP targets, for example, specifically mention women as a special focus within efforts to improve agricultural productivity (2005: 3). In a similar vein, the InterAcademy Council notes the importance of addressing the specific needs of women for labor-saving and more productive agricultural technology. Also, the need "to make agricultural research more client oriented and client driven" for smallholders, including the smallest and poorest of farmers (2004: xxii). In its summary of a conference on Food and Nutrition Security, IFPRI notes the importance of mainstreaming gender considerations in agricultural development and strengthening their roles to achieve food and nutrition security (2004: 5).

CHART OF REGIONAL PRIORITY RESEARCH TOPICS

The following chart presents a synthesis by the review team of priority research focal areas that have been identified from reviewing the many documents in the study. The categories presented were derived through a process which considered:

- The frequency of occurrence and the positioning of the categories in the many prioritization processes, both global and regional that were reviewed;
- The extent of collaboration described in the documents;
- The size and extent of the problem, as well as the regions for which it is most relevant; and,
- The research potential for deriving workable solutions that could make impact.
- Additionally, the following should be noted:
- Each of the categories, in our opinion, should stand scrutiny in each of these dimensions. While synthesis procedures are available for formalizing this type of process, the limited time frame precluded its use.
- The listing makes no attempt whatsoever to prioritize among categories.
- The seven priority "cluster" areas in this regional breakdown have come from a synthesis process from the global cluster areas. They are obviously related to the seven broad "global clusters" which serve as a framework for clustering ALL of the areas and research specifics that were mentioned. These priority clusters are more narrowly defined and now represent a first cut at "priorities."
- The reports listed below for each region and category are illustrative. Only a few of the major citations have been included.
- There are important cross-cutting dimensions of human and institutional capacity, as well as social implications and interactions built into all of these. They are not explicitly stated, but are meant to be integral to the priority areas.

Table 3. Priority Research Areas as Synthesized from Summarized Documents

Region	Soils/Water Use: On-farm Management [1]	Natural Resources Management[4]	Income Diversification through HVC[2]	New Genetic Tools to Support Crop and Animal Improvement[7]	Staple Food Crops in Less-Favored Areas[3]	Markets[5]	Land/Asset Distribution/Rural Finance: Access to Infrastructure and Services[6]
Asia	• FAO • World Bank • APAARI • MDG/Environ	• World Bank APAARI • GFAR MDG/Environ	• FAO • World Bank • APAARI	• APAARI	• IFAD • APAARI	• MDG/Hunger • APAARI	• World Bank • IFAD • GFAR
Latin America and the Caribbean	• IICA	• World Bank • IADB • MDG/Hunger • MDG/Environ	• IICA • Bathrick	• Bathrick	• IICA	• World Bank IFAD IADB • IICA • Bathrick	• IFAD • IADB • MDG/Hunger
Central and West Asia and North Africa	• FAO • World Bank • IFAD • CWANA • GFAR • AARINENA • MDG/Environ	• IFAD • CWANA • GFAR • MDG/Hunger	• World Bank • IFAD • CWANA • AARINENA	• CWANA • AARINENA • Belaid • Campbell	• CWANA • AARINENA	• CWANA • AARINENA	• World Bank • IFAD • GFAR • MDG/Environ
Sub-Saharan Africa	• World Bank • IFAD • IFPRI • DFID • Com on Africa • MDG/Environ • InterAcad Coun • NEPAD/CAADP • FARA	• World Bank • DFID • MDG/Hunger • AfDB • CAADP • FARA • SSA CP	• AfDB • CAADP • ASARECA	• InterAcad Council • CORAF/WECARD • FARA	• IFAD • AfDB • IFPRI • DFID • MDG/Hunger • InterAcad Coun • CAADP • CORAF/WECARD • FARA • SSA CP • ASARECA	• IFAD • AfDB • IFPRI • DFID • Com on Africa • InterAcad Council • MDG/Hunger • MDG/Environ • NEPAD/CAADP • FARA • SSA CP	• World Bank • IFAD • DFID • MDG/Hunger • Com on Africa • AfDB • CAADP • IFPRI

Region	Soils/Water Use: On-farm Management [1]	Natural Resources Management[4]	Income Diversification through HVC[2]	New Genetic Tools to Support Crop and Animal Improvement[7]	Staple Food Crops in Less-Favored Areas[3]	Markets[5]	Land/Asset Distribution/Rural Finance: Access to Infrastructure and Services[6]
Global	• World Bank • IFAD • CGIAR • EIARD • MDG/Hunger	• World Bank • IFAD • CIDA • CGIAR • EIARD • GFAR • MDG/Hunger • MDG/Environ	• World Bank • CGIAR • MDG/Hunger	• World Bank CGIAR • FAO • GFAR • MDG/Hunger	• World Bank • IFAD • CIDA • CGIAR • MDG/Hunger • MDG/Environ	• World Bank • IFAD • CIDA • CGIAR • EIARD • GFAR • MDG/Hunger • MDG/Environ	• World Bank • IFAD • CIDA • CGIAR • GFAR • MDG/Hunger • MDG/Environ

Notes:

1. Integrated Soils and Water Management. Soils and water should be considered together (Asia, CWANA, and SSA).

2. Income Diversification through High Value Commodities (particularly fruits and vegetables, milk, poultry, eggs, and fish).

3. Staple Food Crops in Less-Favored Areas (Asia, CWANA, and SSA).

4. Natural Resources Management (Asia, LAC, CWANA, SSA).

5. Markets. LAC and SSA (and also where Income Diversification through HVC and Staple Food Crops in Less-Favored Areas appear – Asia and CWANA).

6. Combination of Land and Property Rights/Rural Finance (LAC) and Access to Infrastructure and Services (CWANA and SSA). The topic is related to Income Diversification through HVC, Staple Food Crops in Less-Favored Areas, Natural Resources Management, and Markets. Participation and Gender feature importantly.

7. The use of new Genetic Tools (including biotechnology) is related to Income Diversification through HVC and Staple Food Crops in Less-Favored Areas – especially to get at food quality and stress.

US PRIORITIES, COMPARATIVE ADVANTAGES, AND STRATEGY

THE STRATEGY AND POLICY CONTEXT INFLUENCING USAID AG/NRM RESEARCH PROGRAMMING

USAID is already addressing in its current research programming many of the research priorities that have been identified by the various donor and partner consultations reviewed in the previous section. However, the past five years have created a new context for development-related research defined by a host of US government and USAID agency policy and strategy documents that build on both the international consensus surrounding the Millennium Development Goals, the priorities of the US government, and the role of development within the larger framework of US foreign policy. The thrust of these documents is to reorient USAID programming in line with the needs of different types of states – transformational, strategic, and fragile – with different development needs. These new influences will need to be taken into account as the Agency considers whether to continue, initiate, or terminate programs in its current research portfolio.

Under the reauthorization of Title XII in October 2000, the definition of agriculture was broadened to include natural resources management and opened the door to a closer conceptual and practical relationship between these two sectors. It also broadened the scope of partners in agricultural research that can receive support under Title XII funding to include groups in the private sector.

In addition to the revisions to the Title XII legislation, other key documents that summarize US and USAID development priorities and that provide parameters for agriculture and natural resource programming include (in chronological order):

World Food Summit: Five Years Later. The US Position Paper *World Food Summit: Five Years Later* (2002a) was developed and cleared through an inter-agency process. It endorses both the World Food Summit target of reducing the number of undernourished by half no later than 2015 and the Millennium Development poverty reduction and food security goals that are basic to alleviating hunger. Promoting agricultural productivity is identified as the core element for assisting developing countries to achieve food security, particularly in the least developed countries. Attention is focused where the problem is most severe: South Asia and, especially, Sub-Saharan Africa.

The position paper also urges increased actions to:

- Improve policy frameworks (including conflict prevention and resolution mechanisms, democracy and governance, and policies with particular relevance to the agricultural sector),
- Develop domestic market and international trade opportunities,
- Secure property rights and access to finance (with particular attention to participation and gender),
- Enhance human capital, and
- Protect the vulnerable.

It further proposes increasing attention in agricultural science and technology by supporting:

- CGIAR international agricultural research centers, regional agricultural research organizations and networks in Africa and South Asia, and increasing interaction of US agricultural, fisheries, and social

scientists and scientists at universities and national agricultural research systems in low-income, food-deficient developing countries and at the international agricultural research centers.

- Increasing the availability of biotechnology applications that address developing country food needs and agro-ecosystems, particularly addressing biotic and abiotic stresses and micronutrient bio-fortification, involving both public and private partners and building the capacity of developing country governments and scientists to manage the regulatory, intellectual property and research management issues associated with biotechnology.

- Promoting improved technologies and practices to reduce the gap between knowledge systems and technologies available to agronomists, plant breeders, and farmers in developed and developing countries through accelerating the roll-out of applied production packages, improving access to information, and using technologies and agricultural methods that help to protect natural resources (US 2002a).

"*Foreign Aid in the National Interest*." Also in 2002, USAID released "Foreign Aid in the National Interest."[32] It addressed all the key sectors of USAID programming. Agriculture and the explicit need to "get agriculture moving" was identified as an important part of an economic growth program in many countries (2002b: 68). The report noted both global and regional goals for development assistance in agriculture, and noted the need to align the type of sectoral investments considered with the conditions of economic development exhibited in a country. Global considerations related to agriculture include:

- Improving agricultural productivity, implementing competitiveness strategies, building infrastructure, and providing scholarships and technical training;

- Engaging countries in policy dialogue;

- Producing and disseminating new knowledge about development through economic research and other activities; and

- Widening US involvement in trade negotiations and trade processes, and helping partner countries build trade capacity (2000b: 68).

Regionally, the report highlights the key need for improving agricultural technologies and prices in Sub-Saharan Africa, improving the connections between rural production systems with urban and export markets in Asia, and developing strategies to address persistent rural poverty in Central America and the migration to urban areas that it engenders in Latin America (2000b:68).

"*Linking Producers to Markets*." At the end of 2004, USAID launched its new agricultural strategy, "Linking Producers to Markets."[33] In addition to providing a guide for all Agency agricultural programming, it articulates support for the Millennium Development Goals of reducing poverty and hunger through agricultural development by increasing economic growth, creating jobs and investment opportunities, expanding trade, and improving health and nutrition. The Agency's agricultural strategy builds on the comparative advantages that the US offers in agribusiness and trade, community-based natural resources management and sustainable environmental protection, agricultural research and development, and training, education, and information and communication technologies. Within its broad, market-led approach to agricultural development, it outlines four strategic themes:

- Theme One: Expanding global, regional, and domestic trade opportunities and improving the capacity of producers and rural industries to act on them;

- Theme Two: Improving the social, economic, and environmental sustainability of agriculture;

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[32] USAID 2002 "Foreign Aid in the National Interest," Washington, DC: USAID.

[33] The following material is drawn from the Agriculture Strategy, available at http://www.usaid.gov/our_work/agriculture/ag_strategy_9_04_508.pdf

- Theme Three: Mobilizing science and technology and fostering a capacity for innovation; and,
- Theme Four: Strengthening agricultural training and education, outreach, and adaptive research.

Across each of these themes, the importance of developing sound policy environments, the promotion of effective institutions and governance, and the need for gender-equitable participation and access to key assets (e.g., finance, land, education and training, and new agricultural technologies) are highlighted. In two themes, the strategy puts special emphasis on the importance of improving the nutritional quality of foods to enhance human nutrition and to be marketed for higher value, and on employing new approaches for assessments and analysis (including economic analysis) and for employing new technologies and tools (e.g., biotechnology, nanotechnology, global positioning, and geographic information systems) for "the business of agriculture" (2004: 15).

Each theme is interpreted and applied in the context of regional bureau strategies and will be expressed differently through the regional programming choices made by both regional bureaus and field missions.

Initiative to End Hunger in Africa. The Africa Bureau strategy for agriculture is structured by the *Initiative to End Hunger in Africa*. Launched in 2002, IEHA is directly oriented toward alleviating hunger by mobilizing scientific and technological solutions to increase agricultural productivity. IEHA is a partnership with African governments and other stakeholders, and currently includes six focus countries – Mozambique, Zambia, Uganda, Kenya, Mali, and Ghana. It has also developed programs in the three regional missions of east, west, and southern Africa. It is organized around six major themes, four of which are similar to the themes of the Agency agricultural strategy:

- Developing science and technology applications, particularly new technologies, to raise food productivity and exports.
- Improving agricultural trade and market systems in local, regional, and international markets.
- Promoting and strengthening community-based producer organizations.
- Building human and institutional capacity to shape and lead the policy and research and provide agricultural education as well as supporting infrastructure development.
- Integrating vulnerable groups and countries in their transition out of poverty and towards sustainable development processes through the accumulation of assets and by managing shocks.
- Enhancing natural resources management.[34]

Trade for African Development and Enterprise Initiative. A second component of the Africa Bureau regional agricultural strategy includes the *Trade for African Development and Enterprise Initiative* (TRADE) program to build capacity for long-term sustainable trade and investment development.

The Asia and Near East (ANE) Bureau—which covers Asia and much of CWANA—held a sustainable development and food security conference in 2002 and developed a strategic plan that includes:

- Improving economic governance to promote the growth of agro-enterprises and off-farm business development.
- Bridging the knowledge divide to enable farmers and entrepreneurs to gain access to the information they require.
- Investing in information and technology to accelerate outreach efforts and train a new generation of scientists.

[34] These points are summarized on the USAID Website for IEHA, http://www.usaid.gov/locations/sub-saharan_africa/initiatives/ieha.html

- Promoting trade liberalization and market development to support domestic and international trade capacity building and marketing.
- Harnessing advancements in science, particularly in biotechnology, to increase agricultural technology and improve nutritional status of populations.
- Managing the environment to foster integration of environmental planning and natural resources management into agricultural development.

Latin America and the Caribbean (LAC) encourages the production of high-demand and high value-added goods for trade in local, regional, and global markets. Recognizing high levels of income and asset inequality, it also encourages measures that reduce asset-related constraints to participation in market opportunities and improve the capacity of smaller enterprises to take advantage of new trade dynamics. LAC identified four action areas through which to contribute to diversification of rural economies and sustainable reduction of poverty:

- Rules of trade – to help countries prepare for, participate in, and implement rules deriving from commitments negotiated under regional free trade agreements.
- Science and technology – supporting research and applications of biotechnology, food safety, plant and animal health, and communications and information technology.
- Access to assets – to establish property rights systems, rural finance mechanisms, and market services, and develop skills through higher education and vocational and professional training.
- Vulnerability management – to mitigate environmental and economic risks.

Europe and Eurasia (E&E) – the other part of CWANA – focuses on four elements for strengthening the agribusiness sector:

- Accessing the land, technology, and capital necessary for efficient production.
- Establishing strong market linkages between farmers and consumers.
- Developing producer and processor organizations to facilitate technology transfer, economies of scale, and advocacy capacity.
- Improving competitiveness to establish the needed policy framework and common standards, remove trade barriers, and facilitate domestic and international marketing of exportable quality products.

US Foreign Aid: Meeting the Challenges of the Twenty-First Century. In 2004, "US Foreign Aid: Meeting the Challenges of the Twenty-First Century (2004)," a USAID White Paper, and, most recently, the *Fragile States Strategy* (2005), lay out US interests in reducing poverty and advancing development. They build on the earlier framework established in the Foreign Aid in the National Interest report recognizing that foreign assistance needs to be more effectively tailored to the context in which it is being used. In the White Paper, four different conditions are identified, in transformational development countries, strategic states, fragile states, and those in which there is need to provide humanitarian assistance. These conditions do not apply to nations in a mutually exclusive manner – i.e., a strategic state may also be a fragile state. In addition, there are global or transnational issues, such as the need to address HIV/AIDS or trafficking in persons that may be exhibited in several types of states and which will require interagency cooperation. In designing agricultural programs in different types of states, for example, one of the steps required to increase flexibility in addressing fragile states would be to require a shorter planning horizon.

Administrator Natsios has, in addition, announced in recent speeches a goal to strengthen the technical capacity of USAID staff through new personnel policies and the appointment of a senior science advisor and

economist. These actions should lead to potentially greater integration and harmonization of agricultural and natural resources management programming and staffing. In a recent speech to USAID missions that included instructions on preparing field mission budgets for 2007, the Administrator suggested that USAID should:

> *. . . consider new mechanisms for doing our work which build capacity and institutions within national, regional and local governments. This is directly related to our new approach to fragile states and the importance of good governance and democracy to development.*[35]

In review, several themes emerge consistently across this review of US government and USAID policy and strategy papers on agriculture and natural resources management that can help to inform the criteria for continuing investments in the sector. These include:

- Working to create the right policies to support agricultural-led economic growth;
- Improving knowledge about the development process;
- Ensuring support for human capacity building;
- Improving markets and trade;
- Developing and disseminating new and established agricultural technologies;
- Supporting sustainable agriculture programming by linking agriculture and natural resources management activities;
- Attending to the importance of cross-cutting issues including health, nutrition, and gender-equitable access in agricultural programming; and
- Designing programs to address the needs of different national contexts.

AREAS OF US STRENGTH IN AG/NRM RESEARCH AND DEVELOPMENT WHICH GIVE USAID A COMPARATIVE ADVANTAGE

The US has several continually-evolving areas of strength – agricultural and NRM science, technology, human resource capacity-building and policies. All provide a resource base from which USAID can draw for international development purposes, including:

- A university system that sets the standard for world-class graduated training in the agriculture sciences and natural resources management, and that has made major continuing and changing contributions to the development of US agriculture. For decades, it has trained the bulk of agricultural scientists, policy-makers, and agribusiness leaders in the developing world, and still maintains strong ties with agricultural scientists, policy-makers, and agribusiness leaders in the developing world.
- A private sector that has financed and assumed an increasing share of the agricultural research and technology development, becoming increasingly globalized.
- An advantage identifying commercially viable technologies and products due to the integration of biological, physical, economic, and social sciences in US agricultural research. It also does a relatively good job of market research, even in the public sector.

[35] Transcript of the speech of USAID Administrator, Andrew Natsios, May 17, 2005.

- Particular strengths in up-stream science in general, and in biotechnology, in particular, including a strong interest in improving standards to ensure responsible applications. Almost alone among major industrialized countries, the US uses biotechnology in agriculture commercially. The US seeks to develop and apply biotechnology in ways that are humanly and environmentally safe and economically beneficial.

- A commitment to expand world trade, including improving food safety and quality standards in developing countries in order to benefit them, as well as to benefit the consumption demands of the US market.

- A long and successful history of support to agricultural research, policy research and analysis in developing countries through the international agricultural research centers (IARCs), national agricultural research systems (NARS), regional and international networks, and Collaborative Research Support Programs (CRSPs) and other bilateral projects.

- A USAID field presence in many developing countries and, despite declining numbers, agricultural competence at USAID in its Washington headquarters and in many field missions – positioning it to effectively integrate and apply US development capacities in accord with regional, national, and local priorities.

OPPORTUNITIES ASSESSMENT

This section of the report offers direction to USAID for refining its own set of priority research areas out of the many possible topics raised among the priority-setting processes reviewed by the assessment team. It is informed by the results of a workshop of agency stakeholders as well as discussion with USAID staff. Six panel members, composed of distinguished scientists and development practitioners, provided comments and feedback on an earlier draft of this report. In addition, the meeting afforded the opportunity for nearly one hundred participants, representing many USAID-funded agricultural research and development partners and programs, to have an open discussion and raise questions and concerns about the preliminary findings of the report, to raise additional topics for consideration, and to begin identifying which of the many global and regional priority areas and emphases are most appropriate for USAID to continue or begin funding. The input from the workshop led to significant revisions, particularly reorganization of the global research clusters in earlier sections of the report, as well as some shifts among the identified priorities, and a refinement in the set of criteria discussed below.

THE SCOPE AND CHARACTERISTICS OF THE REVIEW

Prior to consideration of the new or continuing areas that USAID might support that will be presented in this section, it may be helpful to quickly recap the objectives of this report and clearly identify the parameters under which the assessment team was operating. Sections III and IV of the report present the information gathered from a review of over 60 individual documents from a wide range of priority-setting processes on both research and development agendas in the sectors of agriculture and NRM, broadly defined. The purpose of that literature review was to draw from the various priority-setting processes an understanding of how different groups around the world perceived the most important topics for agriculture and NRM research for the next 10 or 15 years. The next step was to identify a set of criteria that could be used to reduce the identified topics to ones warranting funding by USAID.

Although the team processed a great deal of material, there are certain areas it did not address:

- *Funding levels*: The team was not asked (see Annex 1) nor did it have access to accurate assessments of the available funding to support agricultural/NRM research, either in USAID or by other donors.[36] The team assumed that within USAID funding for agriculture/NRM research would continue at close to the same levels as it has been for the past few years, without large increases or decreases. It assumed that resources could, in the future, be shifted from current topics towards others if deemed appropriate.

- *Institutional reports*: With only a few exceptions, the report did not review priority-setting processes or annual reports of single institutions, as most of these have already identified a single or related set of research topics, and are deciding on a prioritized list within an already defined range of possibilities. In contrast, the team was looking for those processes that had wide inclusion of a broad range of stakeholders and where the topics for possible investigation were not defined in advance.

- *Scholarly literature*: Although each team member has expertise in different aspects of agriculture and/or NRM research, the team as a whole did not do a systematic review of the scholarly literature on recent or key works in the scholarly literature by individuals. The team's objective was to review and represent the priority-setting processes that involved both scholars and practitioners. There is thus a bias or emphasis on those research topics that have already been vetted as having either potential or demonstrated value,

[36] Recently, both DFID and CIDA have announced plans to increase their funding to the CGIAR system in general (see document summaries in Volume II).

and perhaps an under-representation of new or untested scientifically interesting topics with less of a known application for development.

Starting Assumptions

- *Research can lead to improved development*: The team began with the assumption that agriculture and NRM development interventions depend on the results of appropriate and relevant research activities. In funding research as well as development interventions, USAID can facilitate an interactive process between research and development activities, where results of research inform new directions for development interventions while at the same time, testing of applications in the field identify new problems in need of further research.

- *USAID is committed to continuing support for AG/NRM research*: In addition to the assumption that total funding levels for agricultural research would remain about the same, the team also assumed that the portfolio of activities would continue to include support to the CGIAR, the Collaborative Research Support Program activities, and to a range of other activities relevant to both Washington and mission-level interests.

- *Harmonization of the research agenda*: The team believes that harmonizing the agricultural and NRM research agenda across the Agency is a positive step, following the example of harmonization of agricultural programs more generally – not only research – in the Agency's agricultural strategy, "Linking Producers to Markets" (USAID 2004). Most, but not all of the NRM issues occur either in or with relation to production agriculture landscapes where market-oriented approaches hold significant promise.

Characteristics of the Priority-Setting Processes

This report draws its conclusions primarily, though not exclusively, from the material that was presented in the documents reviewed, but the reports themselves emphasize or deemphasize certain topics according to the interests of the organizations, processes, or stakeholder groups that they represent. This section reviews some of the factors that influenced the shape and content of those consultations.

Several aspects of the priority-setting processes described in the reviewed documents – particularly the extent and type of participation by different stakeholder groups – influenced the outcomes of the consultations, including the selection and inclusion of priority focal points, their specificity, and, in several ways, the credibility of the process itself.

Degree and Type of Participation

Probably the most significant factor affecting the priority-setting processes was the composition of participant stakeholder groups, the interests they had, and with what effectiveness they were able to present and support their positions. Stakeholder groups represented different levels of organization at the regional level:

- *Direct community involvement*: At the level of the priority process-setting of these reports there is little, if any direct community participation, nor is there very much reference to survey data reflecting community input. This does not mean that the processes were not "informed" by adequate, ground-level economic and demographic data. Many of the participating agencies are known to have strong community-level stakeholder interaction.

- *Grassroots organizations:* Many of the consultation processes included "grassroots" civil society organizations working at national, regional, and international levels. These are represented at the global and inter-regional levels (GFAR 2003, CGIAR 2005, FARA 2004) and in most regional fora. Many, if not most, seem well-grounded at the community level. Few examples were found of actual community-based or farmer organizations being represented. In most priority for a, these groups were in the minority, but were usually vocal and served as a strong reality check. They have a strong development focus, and where they do participate in research it is usually at a strictly applied level. They seldom were able to shift

priorities toward their concerns of understanding and better integration of indigenous knowledge, toward resource access by the poor, or toward more "voice" for community groups.

- *Regional research consortia* (e.g., APAARI, ASARECA, CORAF/WECARD, AARINENA, and others). National agricultural research organizations (NARS) were the primary stakeholder groups in most of the priority-setting fora at regional levels. They, in turn, were heavily represented by crop scientists, both biological and economic in discipline. Foresters and agroforesters were present in smaller numbers. Representation of fisheries issues was less frequent. There were also few social scientists. The NARS scientists were very responsive to development needs, including the need for poverty alleviation and reduction of environmental degradation and promotion of environmental sustainability. Research priorities at the regional level tended to reflect the voices of production-oriented biological researchers.

- *Regional development banks* tend to have a development orientation and are involved with downstream research at an applied level. Their agendas are broader than those of the regional fora, and include a balance of economic, social, environmental, policy, production, and capacity-building concerns. The African Development Bank's agenda (ADB 2002) is an excellent example. It picked up the more broad changes taking place in agricultural adjustment such as the shift in trans-humanance (seasonal migration in grazing) toward a more fixed animal production system in the Sahelian zone and the research needs associated with various aspects of that change.

In sum, the concerns at the regional level were characterized by attention to local context and identifying research avenues that promise to solve practical problems of concern to local producers and of interest to scientists working locally.

At the global level, a different set of stakeholders, joined by some of the lower level groups, participated in the priority-setting processes, and their discussions focused on issues at a different scale: e.g., global development priorities, donor coordination, as well as national policy concerns.

- *The multinational organizations* (e.g., World Bank, UN agencies, FAO) tended to structure around the MDGs and address concerns both experienced by and needing cooperation from more than a single nation, such as global warming, climate change and vulnerability, and ecosystem functioning. Their agendas and priorities, except for those of FAO are very much development-oriented, often focusing on development policy research and changes. Where these organizations identify support for a research agenda, the linkages to development are clearly stated. FAO has a broad and far-reaching research agenda, covering most agricultural sectors, including forestry and fisheries. They rely heavily on field expertise for agenda setting, supported by expert consultant input. The World Bank's International Assessment of Agricultural Science and Technology for Development combines a broad stakeholder process with expert consultation and eventual summary of priorities.

- *Bilateral donor agencies* of the developed world employ a variety of processes for priority-setting, with most agendas responsive to market needs, but influenced heavily in many cases by historical country associations, national geographical and geo-political interests, and technical comparative advantage. Most have country and regional staff and expertise providing feedback on development needs. Long-term support of commercial interest seems to be evidenced in some programs.

- *The private sector* played only a small role in providing input in the agendas reviewed. Its participation in regional fora is minimal. GFAR includes very modest private sector input, as does the CGIAR. In DFID's research funding program for the next two years (2005-2007), the importance of the private sector is mentioned repeatedly, but generically, e.g., to promote new partnerships for both financing research and delivering research results. Perhaps the most explicit recognition of the role of the private sector comes from the European Community which, in its Initiative on Agricultural Research and Development (EIARD), lists private sector involvement as one of its eight major areas of opportunity in research, citing examples of public-private partnerships like the Global Alliance on Livestock Vaccines

(GALV) that brings "private sector rigour and marketing expertise to public goods research" (EU 2004: 7).

The Operation of the Priority-setting Processes

The processes described in the reports reviewed are very much dependent upon the institutional level where the priorities are being established. The most common process involves the national program or local institution level, where a single stakeholder meeting, usually convened over a period of a few days, is followed by a summary session with local scientists. This system operates among most NARS and CGIAR Centers. The meetings are nearly always highly participatory, with broad invitation and attendance. Historical trends weigh heavily in outcomes because of project and program continuity. Attendance is often highly skewed because of the local and national level institutional separation of forestry, fisheries, and social sciences research, e.g., from the agricultural science research disciplines. Human nutrition research is rarely well-represented in agricultural meetings (at any level). Participants at this level tend to be heavily research-oriented.

Regional fora and regional organizations like FARA usually use a single meeting format, but with greater disciplinary participation. They often take a broader perspective of needs. At this level a combination of commissioned or invited papers on priorities is usually found (FARA 2003, Belaid et al. 2003). In a few cases (e.g., APAARI 2002 or Belaid et al. 2003), the process has been informed by quantitative survey, congruence analysis among commodities, or other commissioned analysis. A vote on priorities is often done. Outcomes are thus influenced by attendance, moderated to an extent by a secretariat summary. Decisions have a greater input and influence from "expert opinion." Because of the wide geographical and environmental diversity at this level, sub-regions are often defined, and the results tend to be much more general. Sometimes the perspectives that are important to the larger picture are not covered because the priorities are derived in a "bottom up" manner, as, e.g., with the grazing changes in the Sahelian zone of Africa or the massive changes in groundwater across the northern part of South Asia. Historical research trends have progressively less influence at the regional level, as vested project interests are weaker.

Global-level organizations tend to use both regional participant processes and expert commissioned input, and often are informed by quantitative analysis of needs and likely outcomes. The processes are sometimes very expensive, as with the ongoing World Bank consultation process of the International Assessment of Agricultural Science and Technology for Development. That consultation, as well as the CGIAR Science Council priority-setting process and the UN Millennium Development Task Force reviews, can take two to three years. These are heavily influenced by global-level concerns (global warming and other environmental issues, macro trends in commodities, markets, emerging global science trends, and political events, etc.). They have connectivity at local levels, but the voices are very much muted. Outcomes tend to be generalized. They tend to have concern with "marginalized" groups. Development "fashion" has a greater probability of expression at this level. GFAR is of a somewhat different orientation, with smaller budget, a biannual meeting schedule, and broad representation. It relies less on "expert" input. It has reasonably strong civil society input at the global level.

In summary, the agricultural priority literature contains a wealth of participant process outcomes, conditioned and skewed at each level and in many organizations by a host of factors. The broad personal research experience at the bottom (national level) shows itself in a variety of ways. Harmonization with global concerns comes at upper levels. Trends and needs that cut across multiple regions and nations are usually picked up at top levels, and can be verified in regional-level organizations. The very specific needs (for instance, among staple crops for food security of poor people in less-favored production environments) is found at some regional levels as "shopping lists," and must be further verified by multiple sampling of national-level programs after sorting through a different set of biases at that level. International research organizations such as IFDC, the CGIAR Centers, and the regional development banks located in the regions often have a good handle on those specific needs.

Gaps and Omissions

In the detail of the reviewed reports, nearly every conceivable research topic is mentioned at least once and there are many topics mentioned repeatedly that emerge as key areas for investment and have shaped the report's statement of new priority areas for USAID (below). The reviewed documents, however, do not constitute the entire universe of materials to which the assessment team might have turned, and, as noted in the previous section, they also reflected their own interests or emphases.

Several topics that have already been mentioned as underrepresented in the reviewed documents include (listed in alphabetical order):

- Animal nutrition: Many research issues surrounding livestock production systems were well-covered in the priority-setting documents: increasing producer incomes from livestock, environmental problems of livestock production, and the need to address livestock diseases and increase livestock productivity through management issues using biotechnologies for artificial insemination, cell cloning, and genetic research. The importance of livestock to human nutrition was also discussed. Of the general reviews, the topic of animal nutrition and its links to productivity of both meat and dairying was mentioned infrequently, and was an explicit focus only in the AAPARI (2002) discussion for the South Pacific. DFID's proposed research program for 2005-07 specifically cites the need for new technologies to improve animal health.

- Fisheries: The fisheries sub-sector, including marine and coastal capture fisheries[37] and aquaculture were frequently mentioned but rarely discussed in detail in the reviewed documents. Yet the sector is both a major source of employment – not only for the 200 million people who depend directly upon ocean fishing for their livelihoods, but also for small producers engaged in aquaculture in ponds and coastal areas to supplement their incomes. Fish are integral to the diets of much of the world's population, and one of the fastest growing protein sources, providing about 16 percent of the animal protein consumed by humans. Environmental change, policies to stem overfishing, and problems of fish diseases, exotic fish introduction, and fish feed are some of the important areas in need of science-based study. The World Fish Center and the Aquaculture CRSP are both recent recipients of USAID funding.

- Forestry: With the exception of the Millennium Ecosystem Assessment and its description of the key role of forests in the future, few of the reviewed documents addressed forestry or agro-forestry with more than a general statement about its importance in sustainable production systems. The broadened definition of agriculture adopted in the Title XII legislation (2000) and similar ones in use by some other donors (e.g., CIDA, IADB, World Bank in its International Agriculture Assessment) however speak to a need to take a closer look at research forestry and agro-forestry issues, including forests' role in halting or decreasing soil erosion in cultivated areas and their use in carbon sequestration, as well as the need to reduce or suspend harmful agricultural practices that destroy or pollute forest environments.

- Human nutrition: Linking agriculture to human nutrition has been identified by USAID as an important cross-cutting theme in its Agricultural Strategy. The agency funds some research on this topic through its various research grants to the CRSPs, the CGIAR, and other partners. It was not a topic strongly emphasized in the reviewed documents, however, probably because of the historical disciplinary separation between agriculture and nutrition and health that has, in recent years, begun to close, and there are new opportunities to strengthen these linkages in research that would extend the concept of the value chain not only to the purchase by the consumer, but through to the use of the product and its role in food security and nutrition.

[37] Although the focus here is not on the larger marine capture fisheries industry, because of its high degree of commercialization and high levels of capitalization, some ecosystem research topics would also affect this subsector. Coastal fishing and aquaculture are more important for smaller producers and show greater promise for poverty reduction that would benefit from public goods research.

- Integrative research on the linkages between macro, meso, and micro-level processes affecting agriculture and natural resource management: Some attention was given to this type of analysis at the two ends of the spectrum, the macro-level (e.g., impact of trade policies and national economic policies or climate change and variability on agricultural productivity) and some on the micro-level (e.g., identification of producers' constraints or specific commodity issues), but little attention was given to the integrative analysis at all three levels.. The need for "integrative" research was mentioned repeatedly, but rarely were the suggestions specific (note the discussion below).

- Attention to the global food system, the influence of both (short-term) policy and market forces on it, and the environmental and social costs of different options: USAID, the World, Bank, and DFID have funded some research on the changing structure of the global marketplace, but there are new opportunities for additional research on both the opportunities and constraints for smallholder in this process. Little qualitative data nor economic analyses exist about how small producers, including women, are managing the changing procurement systems being instituted by regional and international supermarkets or the gender segregation of farm-level production and processing work in expanding markets such as cut flowers, ornamental plants, and fresh fruits and vegetables. National level data on food quality issues for specific commodities (e.g., the export of Nile perch or fruits and vegetables in Kenya) need to be examined comparatively in a systematic analysis. Other areas for research include the costs and benefits of organic production, processing, and marketing, as well as on the role of consumers in developed nations in supporting or changing these trading networks (e.g., citizen's advocacy groups). Finally, there is the question of how extension systems, whether of the national government or private companies, can address the research needs for these new crops. These areas received relatively little recognition in the reviewed literature.

- Linking agriculture and health issues: Documents reviewed from the African consultations put significant emphasis on the impact of HIV/AIDS on agricultural production and on staffing levels in NARS, extension systems, academic and other research institutions, but linkages between Agriculture and NRM to other health issues in Africa were discussed rarely. Topics in which the linkages were mentioned, in Africa and other regions, included most often, the need for research on the impact of GMO on human health, and, less frequently, on attention to the health effects of pesticides or from water pollution in irrigated systems or in water bodies that receive farm run-off.

- Evaluation research and impact assessment: Several of the global-level reports, including those of the CGIAR Science Council, the InterAcademy Council, CIDA, and others, mentioned "expected impact" as being one of the criteria used in their priority- or agenda-setting processes. The need for better and more detailed research on impact assessment was noted in the GFAR and NEPAD documents, the African Development Bank, the World Bank-led International Agricultural Assessment, and the InterAcademy Council. IFPRI, on its own and in its work with ASARECA, has developed the SAKSS approach for knowledge management and analysis and the DREAM model to quantify the impact of productivity-enhancing investments in agricultural R&D. USAID has noted the need for improved evaluation capacity.

In addition, the team was not able to review documents pertaining to Eastern European AG/NRM research priority setting, a large gap, and felt that the quality of documents reviewed for Latin America was not at the same level as for the Africa, Asia, and CWANA regions.

Integrated systems, ecosystem services, and the multifunctionality of agriculture

The terms "systems integration" and "integrated systems" are found throughout the priorities literature. The terms are either superficially or not at all defined in most cases where they were mentioned. From noting the context of their use, having participated in some of the priorities sessions, and being very familiar with much of the scientific literature on the subjects, one can identify several meanings. In most, but not all cases, "integration" means that the technology or intervention will lead to achieving more than one goal.

Environmental integration usually refers to the selection and use of technologies and policies that both enhance the efficiency of resource use and achieve enhanced productivity, while reducing adverse environmental impact (reducing soil loss, containment of production materials, enhancing water quality, enhancing biodiversity). Economic analysis is increasingly concerned with externalities as well as with valuation of environmental benefits (amenities). Reduced tillage, cover crops, agro-forestry are examples of technologies with multiple benefits, often realized over extended time periods. More narrowly, some priority statements focusing on production refer to environmental integration as the creation and management of technologies to enhance their applicability and stability across a range of environments, making them more stable over time and space. Some of the genetic enhancement literature uses this meaning when dealing with biotic and abiotic stress tolerance.

Social integration refers to selection of technologies and policies that deal with resource access and management through production systems that address a range of social as well as production and economic needs. Empowerment of women and minorities is often cited. Labor use and its balance among men and women, differing age groups, and among the landless are common needs. Additional issues include income distribution within families and across the community.

The need for integrated production systems are commonly mentioned by production scientists. For animals, this refers to the matching of animal breeds with feed and nutritional needs, health requirements, investment and security needs and market requirements among others. This is especially prominently mentioned with the changing structure of livestock systems in CWANA and in the Sahelian zone of Africa where seasonal migration has been giving way to more sedentary systems with the deterioration of rangeland, the pressures for more permanent settlements, the narrowing of grazing corridors and the requirements for enhanced quality of animal products (AARINEENA 2000, African Development Bank 2002, InterAcademy Council 2004). Crop scientists often use the term for crop selection and management in intensive production systems, including weed and pest management, tillage, water use, and other factors.

Multifunctionality refers to the overall result of landscape-level management whether at the farm, community, or sub-regional levels to achieve a range of product and amenity outputs and their influence on several resource domains (social, environmental, economic, bio-geophysical, infrastructure). The term (and concept) came to agenda status with the Rio Declaration on Sustainable Development in 1992 and the FAO World Summit of 1996. It has become highly politically-charged in the past few years through trade negotiation and reform of the WTO. Much of the economic and social literature has evolved in Europe, with the debate over trade implications spreading to Japan and Australia.[38] Multifunctionality of agriculture and land is especially important for low income farmers and communities, and for those in harsh environments at a distance from markets where a range of environmental services is critical to food security and well-being. In a more limited sense, it may simply refer to the local production of firewood and building materials as a part of production agriculture. Environmental economists in the US are very appropriately working on valuation of services, with focus on hydrology. While the principles of multifunctionality are important as agricultural components, the top-down, trade-reform orientation, and political controversy surrounding the debate add considerable baggage, and its lack of contribution to theoretical production concepts limits its usefulness as a basic research framework.

Production ecology on the other hand, builds on a framework containing the multiple dimensions of ecosystems, including resource allocation and management, management of biodiversity and of pests and weeds, and attention to stability and/or resiliency of the overall systems. It deals with the several forms of systems productivity in ways that serve the multiple needs of agricultural development. It incorporates a wide range of scientific theory. Definition and quantification of gradients of change in the "drivers" of production

[38] For a recent review of this literature, see I. Garzon,. "Multifunctionality of agriculture in the European Union: Is there substance behind the discourse's smoke?" Seminar presentation at UC Berkeley, April 6, 2005. Available at www.agroecon.ucdavis.edu/uploads/seminars/multifunctionality.

ecosystems and the placing of technologies along those gradients is increasingly seen as a way to "embed" the technologies and make them and their management more adaptable, reducing their location-specificity. There is a broad and growing production ecosystems literature, both in North America and in international development. In developing countries, and in several of the reviewed priorities the reference is to integrated natural resources management (INRM), referring to a highly participatory, production ecology approach to research (Harwood and Kassam 2003) as used by the CGIAR Centers and their partners. This approach is used to enhance ("enrich") INRM technologies which otherwise might be highly location-specific and broaden their applicability as international public goods (IPG) (Harwood et al. 2005).

Every one of these meanings is found either stated or implied in the literature reviewed. Integration is a critical need in situations where environments are fragile, there are competing uses for resources (as population density and economic activity on the landscape increases), as environments become more fragile, and as production systems become more environmentally intrusive. Research needs are obviously more complex as the need for integration increases. Modern tools of ecosystems science, of geographical information systems, of systems modeling and of research design are increasingly in demand. The multidisciplinary approach and complex partnerships required are often beyond the capacity of small NARS to adopt, requiring a range of technical assistance. That assistance, provided through regional or international partnerships will be crucial for the foreseeable future in many regions. The literature strongly suggests that appropriate elements of an integrated approach are important, if not major requirements, in nearly all technical assistance in agriculture. Human and institutional capacity development certainly requires that dimension.

There are some instances of technological input where the provider may not have responsibility for integration. Where a collaborative partner brings a specific area of science to the group effort, they may not have integrative responsibility. Such may be the case with some elements of biotechnology where the input is upstream, or fundamental. Ex-situ germplasm conservation and characterization and specific trait identification and description is another. For most application research, however, all providers must be aware of the integration efforts required of the teams with which they are engaged.

The Changing Global Context of Agriculture

In carrying out its agricultural programs, USAID and its partners must take into account the new global context within which food and agricultural systems now operate and assess and prepare for probable changes in the future. As listed in Section II, some of the key trends affecting agricultural and NRM research include dramatic innovations in communication and information technologies, in scientific techniques such as biotechnology, and in increased cross-border flows of investments and trade. HIV/AIDS and other infectious diseases have emerged as a growing public health problem that threatens food security and agricultural productivity in many developing and transition countries. Climate change and natural resource management became critical influences on agricultural productivity. The role of governance has also changed, as greater global consensus on development issues is parallel by larger and more complex tensions, including terrorism and war at the same time that the importance of local governance is also growing. The combined impacts of these social, political, economic, and technological transformations have been enormously far-reaching, affecting producers, researchers, and donors.

Today the seed planted by developing and transition country farmers is likely to contain genetic sequences or parental materials generated, and sometimes inserted through assistance of international genetic programs carried out by U.S. universities and the international agricultural research centers of the CGIAR or by the private sector. Herders and fishing communities face encroachment of their lands and climate variability that affect the productivity of those lands. Producers must respond to new market demands, providing both opportunities and challenges. A rising portion of the producers' harvests travel to domestic, regional, and international markets destined for consumers in distant cities and foreign lands. Off-farm employment and enterprises contribute an increasing share of income in farm households. International and domestic standards for food safety will determine how much of the crop makes it across national borders and,

increasingly, will shape local quality preferences and standards. Increasingly, the profitability of agricultural and NRM enterprises will be shaped not only by the local vagaries of weather and soil, but by world trade standards, changing consumer preferences, and international advancements in science and technology.

LEVELS OF CRITERIA IN THE "FILTERS"

The process of globalization and the changing context of food, fiber, and feed production and marketing requires that any criteria for screening areas of agricultural research for development investment, for a global organization, must address, though a conscious "filtering" process four different levels of priority screening These include:

1. Global-level conventions and development goals that apply to the organization.

The US position paper, *World Food Summit: Five Years Later* (2002a), endorses both the World Food Summit target of reducing the number of undernourished by half no later than 2015, and the Millennium Development Goals of poverty reduction and food security that are basic to alleviating hunger. A list of primary considerations is present in each. These, along with the convention on biodiversity which the US has ratified, provide key elements in USAID's development umbrella. The areas are broad, and serve to reinforce and validate key areas of agricultural development. Validation of global acceptance is found in the concurrence with priorities of other global development organizations, which agree with the common set of global goals. Several of the priority processes reviewed were of this type.

2. The recently adopted Agency strategy for agriculture.

The USAID strategy articulated in "Linking Producers to Markets" outlines four strategic themes, providing a second, institutional level of filtering. In the market-led approach to agricultural development, the four themes are oriented around trade, sustainability of agriculture, technology access and the capacity for innovation, and the human and institutional capacity for adaptive research and outreach. This provides the desired orientation of the key development areas toward market-driven growth. It proscribes both content and form of the portfolio, and suggests the directions for technology orientation.

For USAID to be responsive at both the global level and to its own strategy, and to align its portfolio with MDG goals, its portfolio must contain elements of these interrelated components:

- Capacity to develop policies that enable growth to take place;
- Development of policies and institutions that enable growth and natural resources management to be inclusive and pro-poor;
- Policies, institutions and technologies that sustain the natural resource base, and;
- Technologies that provide growth opportunities.

3. Development needs and priorities at global, regional, and sub-regional levels as determined by the multiplicity of stakeholder-driven processes.

A high proportion of the more than 60 priority-setting studies reviewed focused on this priority level. The categories at the regional and sub-regional levels are broad, and were arrived at through highly participatory, iterative processes involving stakeholders at multiple levels. These processes were informed by a range of data inputs and analyses, but in the end, were decided by weight of both data and informed scientific and development judgment of professionals engaged in many facets of the development process.

4. Specific program and project-level screening for selection within priority areas.

At this level, considerably greater quantitative analysis is possible to assess feasibility, the potential for impact in the economic, social, and environmental realms, and to determine capacity for monitoring and assessment. Additional discussion of criteria to be used at the activity level is discussed below.

In sum, the four levels of criteria just mentioned, each have different characteristics, ranging from global development goals, to agency-level strategic objectives for addressing global goals, general development and research needs specific to regions, and finally selection of specific technology and policy targets for research. Quantification of comparisons in economic, human impact or physical terms is rarely possible for the top three levels. Such comparisons are possible for some (if not many) of the choices at the regional levels.

Just a few examples of these processes will be given here:

The World Bank's International Assessment of Agricultural Science and Technology for Development (Steering committee 2003) begins with acceptance of the MDGs as the top global filter. It then used a broadly-based series of stakeholder consultations at many locations in developing countries to obtain a first assessment of development priorities. It is following with a series of expert analyses by agricultural development sector, to be followed by extensive stakeholder review and revision of global, regional, and national development needs. Its framework is one of process, rather than of analysis.

The CGIAR's Priorities exercise started with the CGIAR's Vision document, and the harmonization of its seven "planks" with the MDGs. These documents provided the global criteria for CGIAR involvement. Several elements of deductive analysis, including historical priorities, a modified congruence analysis with poverty weighting among commodities, and contributed scientific summary papers were then used to inform the following stakeholder processes. Several phases of inductive analysis included a broad, stakeholder electronic input, global and regional expert panels with electronic conferencing, expert review, and finally multiple stakeholder sessions to detail each priority area derived from the previous steps. No formal framework for decision-making other than the global guidelines was constructed, with priorities emerging from the informed inductive process

In CWANA, an informed, iterative stakeholder process was conducted over several months (Belaid et. al. 2003). The ICARDA/ARINEENA process experimented with a formal stakeholder survey used to assess priority commodities and research areas among its five geographical sub-regions. Nearly all priorities varied greatly by sub-region. An attempt to assign priority weighting to productivity, poverty alleviation, resource conservation, and food security varied greatly by sub-region, and was thought to be highly influenced by the research discipline and program interest of the respondents. Familiarity and vested interest were strong influencing factors.

The Strategic analysis and Knowledge support Systems for Rural Development Strategies in Sub-Saharan Africa (SAKSS) process is formulated on the basis of a planned, ongoing investment of data gathering and analysis, and the characterization and analysis of alternative investment strategies (Johnson et al. 2004). Its early assessment, as one example, using a multi-market assessment model for commodity options in Eastern and Central Africa indicates significant potential for increase in GDP from investment in the major commodities targeted at meeting internal market demands, with focus on potential for increase in many of the less-favorable environments (Omamo et al. 2004). The SAKSS process thus represents a coordinated, analytical approach to informing research and development decisions at national and sub-regional levels, where specific alternatives can be quantified.

CRITERIA FOR SCREENING GLOBAL PRIORITY RESEARCH AREAS

This section presents a list of criteria that address the first three of the four levels just discussed. The criteria themselves and the discussion of them reflect the input from USAID staff and partners. Each criterion should be understood as representing a continuum, even though in practice the response might most feasibly be made as a "yes" or "no" answer. No one end of the continuum is the "right" one or the "best" one in a universal or absolute sense.

The first four criteria are proposed as a way to assess a research activity area against the global-level goals as filtered through the USAID market-oriented strategy:

- How well does the proposed research topic or approach support the first MDG to markedly reduce extreme hunger and poverty?
- How well do the proposed research topic or approach fit within USAID's agricultural priorities through use of market-oriented strategies in addressing hunger and poverty, and promoting environmental sustainability?
- How well is the proposed research topic or approach able to support the development needs of transformational, fragile, and/or strategic states?
- How well does the proposed research build on USAID's (and the US's) comparative advantages?

An additional four criteria are proposed as a way to assess a research area against the results of the priority-setting processes of the many global, regional, and national institutions and fora:

- Is the proposed research high on the priority list of multiple agencies at global and regional levels, with indication of acceptance and support, and does it have widespread applicability with potential to have the broad impact of MDG #1?
- How well does the proposed research enhance agricultural productivity and natural resources management linkages?
- To what extent does the proposed research apply cutting-edge scientific applications to solve development problems or offer an extension of proven methods?
- To what extent does the proposed research use an innovative, integrative perspective, either by using new technologies to link different sources of data (e.g., GIS) or interdisciplinary or other approaches to analyze the development process itself?[39]

The first set of four criteria emerged from the review of USAID strategy and policy documents; the second set of three criteria emerged from the literature review. It is not suggested that a proposed activity would match all the criteria, but that it should fit several, and the set of chosen activities would together fulfill the set of criteria. In order for USAID to achieve an appropriate balance in its portfolio, for example, it may want to include support for both cutting-edge science as well as support for ways to get existing technologies "off the shelf" and on to the fields of poor farmers or into the hands of processors and exporters.

Similarly, the relative "weight" of importance of any one of these criteria will vary by region. For example, it is probably much more important to build scientific capacity in Sub-Saharan Africa today than it is to do in some parts of Asia, where networking among scientists in different countries might be a higher priority. Some projects would be regional. The issue of which priority staple commodities to address in less-favored areas is different for Africa than for Asia. Soil and water management would be different for Africa as compared to

[39] This was labeled a "science of development" in the comments of Michael Carter and Tag Demment at the June 8, 2005 workshop.

Asia. On the other hand, some problems, such as those dealing with specific techniques, e.g., biotechnology, might be addressed globally.

PRIORITY AREAS SUGGESTED FROM THIS ANALYSIS

These individual areas have arisen through application of the criteria above. Each one strongly meets every criterion. As a group, the listed topics have been considered for portfolio balance, as will be shown below. They are listed individually to emphasize the importance of each topic, but several would often, if not usually, be implemented as integrated research packages to enhance likelihood of adoption and broad impact, nearly always through partnership organizations. The team sees research in all seven areas as essential to building a research program that can contribute to successful agricultural development and environmental sustainability in the future.

1. Human and institutional capacity-building.

Human and institutional capacity-building is a critically important development goal. It is a by-product of many implementation efforts. It has been the strength of many of USAID's agricultural training and mentoring programs, including those carried out by the CRSPs and the CGIAR, as well as the new training activities developed with the help of BIFAD. Virtually without exception, the reviewed documents stress the importance of building capacity in the multitude of sub-sectors related to agriculture and NRM development efforts – not only in the sciences, but in building the capacity for trade, policy analysis, institutional management, gender analysis, and many others. The Commission on Africa asserts "the need for capacity building and accountability are primary areas of change that influence all sectors and programs within them" (2005). It is an area that has provided high returns and which has been a major comparative advantage for the US. Although essential to all research and development activities, human and institutional capacity-building needs are different in different regions – in Africa, the emphasis should be on degree and short-term training; in Asia, on strengthening scientific networks. African agricultural research and development programs are now undergoing analysis from several sides to determine the most appropriate future structural linkages, points of excellence and division of responsibilities both for national institutions and civil society groups, and for linkages of all of this to assistance organizations. It is critical that USAID stay abreast of directions of change, and be supportive and participatory as appropriate.

As aptly noted in the new DFID research program proposal, however, capacity-building is not only an implementation issue, but also a significant research opportunity, by putting greater attention on not only the "what to" but also the "how to" (2005d: 5, 7). For example, what is the best approach for providing graduate study in the world today, with tight visa restrictions on foreign students pursuing academic program in the US? What are the possibilities for using third-country locales, sandwich programs, and distance-learning? When are short-term courses more effective than longer-term degree programs? IFAD has identified strengthening the capacity of the rural poor and their organizations as a key priority, but what are the best options for strengthening the business development capacities of these groups? What are the most critical problems that HIV/AIDS infections are creating for research and extension programs? The National Research Council study (2004) of USAID S&T suggests there is a need looking beyond current program needs towards innovative mechanisms for building international science capacity. These are only a few of the possible research areas that could be built into existing programs or made to be the focus of new activities.

Institutional capacity building extends beyond the individual student, scientist, or participant training program. It includes ways to assist developing country and US institutions in learning how to administer funds and programs, to improve decision-making and priority-setting, and to enhance the institutions' abilities to implement, monitor, and evaluate on-going research. Research is needed to identify the critical areas for support that would have the highest payoff in improving program management as well as scientific excellence – training, incentive structures, planning, budgeting, etc. – and to investigate "best practices" for achieving these goals. USAID needs to recognize that this component of institution-building, along with degree training, is an important part of research success.

2. Policies and institutions that help to create pro-growth environments.

The role of policy in shaping an enabling environment has been increasingly recognized by donors and national governments as key to achieving sustainable development. In the agriculture and NRM sectors, there is special need for improving the policy environment to support scientific and technological development, reform higher education, enhance opportunities for innovation, and foster business development. A supportive policy environment maximizes the likelihood that research results will be adopted, applied, and disseminated for greater productivity and sustainability. Particularly important are changing government policies to enhance access for smallholder producers and other agricultural and NRM entrepreneurs to regional and world markets (domestic and international trade policies), as well as to build the capacity of developing country governments in these areas. Several sources speak to the policy bias against agriculture in developing countries and the trade barriers put up by developed countries, calling for reform in both camps. Improving national macroeconomic policies is critical (World Bank 2003) to support agricultural trade and market access, as well as markets for agricultural inputs and services, and to facilitate entrepreneurship. Governance in the food and agricultural sector needs to be addressed at the macro, as well as sectoral levels.

Good policies require effective institutions, and there is significant research that can be done to identify the most appropriate institutional arrangements to facilitate policy formulation and policy implementation and to establish administrative systems for land and water management, topics that are a major component of the NEPAD/CAADP initiative. The CGIAR proposes to make research on institutions one of its core priorities, addressing such topics as improving the capability of institutions to support innovation and to be more innovative themselves, to improve institutional accountability, and to enhance institutional partnerships (supporting MDG #8 on development partnerships).

As in the case of capacity-building, the issue of policy reform and institutional change is both an implementation and a research issue. Each of the topics listed above would benefit from focused research that examines policy alternatives and their impact on agriculture and sustainability. Several key areas have emerged as important topics for policy and institutional research, including:

- the political and institutional factors that promote or inhibit innovation and entrepreneurship;
- the factors that encourage institutions and mechanisms to articulate science and technology policies and to encourage greater access to global knowledge and technology;
- which policies or types of policies are needed to ensure biotechnology development and biosafety in developing countries, as well as related policies on intellectual property rights;
- policy research on international trade barriers; better understanding of trade policies impacts on agriculture; and research to link technology policies and industrial policies;
- research to provide better ways to get policy advice to government officials;
- the interface between technological change, institutional change, and policy environments – an interest of the regional organizations; and
- identification of mechanisms to help smallholders offset negative impacts of global change and exploit new opportunities in the global systems.

As with many of the priority areas, it is likely that policy recommendations could be most effective if leveraged against other research outputs such as major improvement in technology and marketing generated be other projects. Linkages to other USAID-supported projects are strongly suggested.

3. Resource access and broadened participation.

To help ensure that the research program contributes to the pro-poor orientation of the MDGs, support to research on a number of dimensions of access is critical, including:

Assets: Many key documents assert that the larger goal of improving agricultural productivity and environmental sustainability is to (1) improve social well-being, broadly understood; (2) reduce poverty and hunger, (3) improve health and nutrition, and (4) conserve natural resources. When access to assets (such as land, water, and finance) is unequal, it often reflects intractable patterns of inequality that constrain agricultural productivity, sustainable resource management, and limit opportunities for income generation. Research to identify ways to improve rural inhabitants' access to productive assets is an important area, including attention to tenure security, information, water and other natural resources, and finance.

The boom in research on urban microfinance programs, particularly among women, was not paralleled by attention to rural financing systems. While there is wide agreement that rural financing can stimulate rural enterprises, there is not a similar agreement about what such a system might look like. With the move towards higher-value products (horticultural, livestock, dairy), some financing services are being provided through private sector input suppliers and/or processors and wholesalers, as well as by the expansion of rural producer groups. Emerging areas for research include insurance programs, information technologies, and building of market linkages with the participation of financial institutions, and word on credit programs.

Research on tenure security of land and other natural resources, including collective property, has been a significant focus of USAID-funded research in the past and should continue to be a significant topic of investigation. Enormous change is occurring in rural areas as inhabitants adapt to the exploding growth of markets, effects of HIV/AIDS, expansion of development, ecotourism, and industry into previously isolated regions, and the impact of information technologies are all changing what was thought known about property rights and tenure issues and opening up new and critical topics for investigation, such as research on the wildlife-livestock interface in areas where cultivation and habitation are increasing as well as new techniques – including the use of producer and/or community associations – in rangeland management.

Information is another key asset that is becoming increasingly critical in a market-let agricultural and NRM strategy. Research on what information is most needed by participants at all points in the value chain and how best to provide greater access is needed. USAID has been funding efforts in this area and should continue, e.g., in developing market information systems, climate variability, pasture and forage conditions, agricultural extension – including through both private and public sector input providers, and other topics.

Market access: There is strong consensus among all the global and regional priority documents about the fundamental importance of improving market access and operation, opening up national, regional, and international trade, and supporting greater competitiveness. The importance of "linking producers to markets" is the organizing theme and title of the USAID agricultural strategy. Both US and other donors, as well as national governments, have shifted from a belief that markets could, independent of policy change and public sector involvement, transform rural sector economies supporting agriculture, entrepreneurial development, and environmental sustainability, paralleled by the realization that sustainable development needs market linkages at all levels. Relevant research on the operation of and impediments with value chains is needed, including analysis of what are the most appropriate crops for producers to produce (e.g., high value horticultural crops and other non-traditional products, including natural collected products, livestock, dairy, and fish), but also on needs for processing, cold storage, and packaging options in support of production.

Infrastructure and services: Improving rural infrastructure is one of the three pillars of the NEPAD/CAADP program, and is a precondition for many of the other implementation and research issues that have been listed in this report. Infrastructure includes not only the physical components, (e.g., air/rail/roads/dams) but also other structures and institutions that make it easier for producers to obtain access to the items and services they need to improve productivity and market involvement. Economic and policy analysis, in particular, are key research areas to assist in addressing linkages between agricultural and

natural resource management and infrastructure and removing key constraints. Irrigation management is another related research topic.

Participation: After years of rhetoric about the importance of participatory research, there is now a growing and increasingly sophisticated science of participation that encompasses not only the well-established use of participatory research along the lines of "farmer to farmer" schools but also greater reliance on the formation and support for rural producer groups, social inclusion, and gender integration. Both donors and national governments have made participation a foundational part of their implementation programs, and research is badly needed to help move these efforts beyond the lip-service, to make participation helpful to both scientists and to producers. Ways to improve participation, particularly of resource-poor producers, should be investigated for all parts of the research process, from design to monitoring and evaluation.

As has been noted in each section, the agricultural strategy focus on linking producers to markets provides a clear framework for research in this sub-topic.

4. New tools (including biotechnology) for genetic enhancement to solve the most difficult plant and animal problems of biotic and abiotic stress and of food quality.

Genetic improvement for crops remains as a high priority for every region, and most national programs. The public sector capacity in Asia and Latin America, where it has been an area of concentration for several decades, is reasonably high in countries with advanced NARS; smaller countries and NARS, particularly in Africa, have less capacity. The private sector has developed significant capacity in Asia and Latin America, but has less investment and fewer resources in Africa and CWANA. The needs and demand for international assistance in breeding for finished varieties thus continues to decline, particularly where advanced NARS are present. The CGIAR centers, in fact, have long since stopped releasing varieties in those areas to avoid competition with national programs.

There is nearly universal interest shown by regional fora for developing capacity and eventual use of biotechnology as country after country adopts biosafety protocols, or plans to have them in the near future. Many of the smaller NARS look to strong regional institutions for guidance and assistance, and may contribute to development of those centers. The US is seen as a leading source of technologies and policy for biotechnology. This area of science is one where NARS will need assistance, either international or through regional centers for the foreseeable future, if not on a permanent basis. No one can (or should) invest to attempt self-reliance in such a rapidly growing and complex field where common protocols and increasingly, where genomic platforms are being created for identification and provision of gene sequences for solving some of the most complex problems will become increasingly common. Programs will continue to need access to training, to genetic material, to help in sorting through complex intellectual property (IP) issues, to identify sequences for the most important disease and pest resistance (to counter biotic stress) and to reduce drought, salinity, and other abiotic stresses, to enhance food quality, and to identify appropriate protocols and policies for food and environmental safety.

Crop improvement, particularly enhanced by biotechnology is a major scientific breakthrough area where the US now enjoys major comparative advantage, in both public and private sector institutions and in policies for health and environmental safety. When applied to the areas of biotic and abiotic stress, it can have major impact on productivity in stressed environments and on the well-being of poor people living in them. Food quality enhancement, particularly of the staple commodities which is being supported by US public and foundation resources, has significant potential to improve the nutrition and health of poor people who depend upon them in most parts of the developing world, and to allow many in Africa to contribute to national GDP.

Areas of significant need, as expressed repeatedly in the priorities literature include:

- Maintenance breeding of the major staples (in all countries, but with assistance needed in Africa and CWANA);
- Genetic improvement for tolerance to biotic and abiotic stress (in all regions, but particularly CWANA and Africa). African priorities particularly focus on the low soil and water resource areas of SSA. Several specific needs are mentioned for Africa including striga resistance in sorghum, millet, and maize;
- Improvement in both food quality and in feed quality for all regions;
- Molecular tools for identification of races of pests and pathogens in both crops and animals;
- Gene search for genes of particular need and inclusion of these materials in parental lines;
- Bioinformatics to assist molecular work at all levels; and
- Biosafety policy standards.

Animal genomics work is well advanced for fish and many breeds of livestock. Improvements in several fish species for aquaculture show enormous promise. This work has so far had little impact in developing country fish culture. Work with fish, according to the priorities, would focus on small-scale production systems for widespread impact on poverty, rather than the large, capital-intensive systems. Those large systems have their definite role, but are already highly financed and supported through the private sector.

With livestock, vaccine development against the major diseases seems to be of highest priority. Links to nutrition and the ability for improvement of ruminant nutrition through breeding or manipulation of digestive flora has promise, but did not appear in the priorities listing. Kits for the identification of disease strains are in great demand.

USAID should focus its programs in genetic improvement with a view of linking the NARS appropriately to advanced centers for long-term development and assistance. The crops and regions of interest should focus on food security and incomes of the rural poor, particularly in areas of soil and moisture stress. Such crops include sorghum and other major staples grown in low moisture areas. The US may not have comparative advantage in the root and tuber crops, but could well partner with those who do to bring appropriate technologies to bear.

5. Soil and water use and management.

In both water and soil management, improvements and resource productivity and sustainability must be done through integrated systems. Market structure, policy, and ultimate efficiencies will be critical. USAID assistance programs for soil and water use must be integrated into landscape-level management of crop and animal systems. The need for an "integrated" approach to these problems is found throughout the priorities literature, as summarized above, as these elements cannot be separated in research programs.

New and existing technologies and management systems would be researched within the framework of sustainable crop, animal, and tree systems. This topic is a very high priority throughout Africa and CWANA, and in the low resource/fragile areas of Asia and Latin America. The application of reduced/zero tillage is beginning to make major inroads in parts of Asia, and has major and long-term potential in vast fragile-soil areas of much of the world. The US has a major and clear comparative advantage with reduced tillage systems, the science of soil change, and the hydrological improvements with reduced tillage, and in the necessary technologies to implement them. Soil deterioration both through erosion and more commonly driven by the loss of carbon is a major factor in reduced productivity.

The lack of effective market channels for fertilizer, coupled with its highly inefficient use in degraded soils, is a major factor in the low productivity in Africa and parts of CWANA and in an increasing number of fragile soil areas of Asia and LAC. International assistance in soil management for Africa and CWANA, in the viewpoint of these reviewers, has been heavily influenced by European and Australian soil science assistance. There has historically been little or no interest from those sources in reduced tillage. There has been interest in soil ecology and biology, but without at least some reduction in tillage, such changes tend to be marginal. With reduced tillage they can be highly effective, and the inclusion of organic sources to complement the use of fertilizers could accentuate the soil-building effects. In the resource-poor areas, the integrated use of fertilizers and local organic resources, together with crop diversity require a range of scientific and input market interventions.

Water use technologies intersect with crop and animal production systems, with modern crop genetic applications, and are supported by modern information technologies. The US has long-term and highly successful experience with community-based water-user and conservation associations which are critical to this improvement. Assistance is badly needed in Africa with effective distribution and use in both crop and livestock systems. In CWANA, water use and allocation is at the top of the priority list.

Several areas of expertise, including social science and policy must be overlapped and integrated with the biological sciences, using innovative program design and institutional partnerships. There must be accountability at multiple levels in the partnerships. USAID has a strong history of such interdisciplinary work in both farming systems and, more recently, landscape-level conservation and sustainability research that provides direction for future programs.

6. Staple food crops and livestock in less-favored areas, supported by effective soil and water use and on-farm management of these resources, together with market development.

This category of research topics would potentially impact the largest number of poor people, with potential for economic impact seemingly great according to several years of work by Hazell and colleagues at IFPRI. Recent analysis for East and Central Africa within the SAKSS umbrella, continuing the IFPRI involvement, confirms that such focus would have significant impact on GDP for those areas. The low yields and low productivity in those areas has a complex set of interwoven factors, including crop genetics, lack of inputs, poor market channels for product, deteriorating soil and often limited rainfall. These areas have significant concentrations of poverty and of environmental degradation. Animals nearly always play a key role in such production systems. Markets, structure of the industry in many cases, and the demographic shifts in many of these areas are forcing rapid changes that require considerable research input and assistance for sustainable evolution without serious environmental degradation.

Research inputs would be required in several disciplinary areas through well-coordinated programs. The programs would have to be of intermediate-term (5-10 years or more), requiring a long-term commitment to the countries involved. They would clearly target large numbers of poor and food-insecure people.

This area of work is one of significant US historical development assistance and comparative advantage, particularly through integration of modern genetics with natural resource use in integrated, sustainable systems. A fresh look would be required to define target areas for Africa, CWANA, and possibly the bypassed areas LAC. For Asia, inputs could be more specialized. One approach could be to identify large areas where staple crops would have the lead, and those where animal research would lead based on predominance of the commodities and potential for improvement. It must be stressed, however, that without significant improvement in soil productivity, effective IPM and disease control along with effective economic (including market) policy, none of the crop or animal improvements will have more than marginal impact.

In much of the desert margin areas of SSA a major transition is underway in the structure of the livestock sectors. Traditional grazing systems are under enormous pressure from increased population densities and more and more land being fenced, and narrowing of traditional seasonal migration corridors. Livestock operations are becoming more concentrated, with larger herd sizes and the need for improved feed

production. Increased crop productivity for both feed and for human food security is critical in these areas. Animal nutrition, the processing of feedstocks, changing patterns of pests and animal diseases, and changing market structures all require new technologies and market policies. Animal health and product quality are increasingly important.

In CWANA, animal systems are crucial, and under severe stress because of high and growing animal numbers and a decline in rangeland productivity. Staple crops have more specific genetic improvement needs. In LAC, particular groups of people and geographic areas lag far behind the market economy of the more progressive areas. For all of these areas, clear topical and problem identification is critical. Program structure will have to be very different from past approaches, and partnerships both in the US and in target regions will have to be carefully thought through.

7. **Income diversification through High-Valued Commodities (HVC) to include fish and livestock, relevant soil/water use/on-farm management, food quality and safety, with value chains influencing respective markets**.

This category would potentially impact a smaller number of poor people but progress would be relatively fast in moving numbers/proportions of the food-insecure, low income people. With growing wealth, expanding markets, and the globalization of food trade, priority-setting in every area has earmarked this topic. The globalization of trade has forced countries in every region, as seen in their stated priorities, to be concerned with food safety and access to market channels.

The policies and structures needed to address this area are particularly relevant to the evolution of sound development policy. With projected growth in the supply of the global staple crop commodities, high value products will not only meet market demand, but will diversify production to the benefit of small farmers with a labor resource and need for cash income. The clear intent of the regional priority activities in this area is for market, rather than subsistence focus for generation of cash income.

The primary emphasis on high value crops from the production side, in part because of the great diversity of crops that may be suggested, will most likely focus on providing access to existing genetic materials or to those being developed by existing centers, and having new market potential. Production assistance would most likely focus on fertility, pest and disease management, and quality control.

Animal and fish culture systems, particularly in Africa, may require carefully-targeted and focused breed and species selection and improvement.

No high value product production development should occur without market chain creation, probably with nearly equal and parallel effort. Experience is showing that without producer and community involvement and influence in the market (and value chain), significant returns to producers and communities are unlikely for very long. The creation of value chains increasingly involves branding, labeling, and identity preservation in some countries, and farmer-linked networks of information and influence.

CRITERIA FOR SCREENING SPECIFIC ACTIVITIES WITHIN PRIORITY AREAS

The preceding discussion shows how the criteria discussed earlier influence the broad categories of research selected for USAID research funding. Once the priority topics are chosen, the Agency must refine its list with greater specificity in order to design programs that cover a range of related activities or a single activity as a pilot or stand-alone project. The criteria for choosing which specific research activities to fund are primarily practical ones,[40] and are discussed in this section. There is no formula for "weighting" the different criteria listed below.

[40] The team thanks the speakers and participants at the June 2005 stakeholder workshop in Washington, D.C. for many of the suggestions in this section.

The proposal evaluation process would include, in addition to the programmatic criteria discussed below, the normal criteria for quality of science, probability of success, capacity of the partners, budgetary consideration, and other issues. Currently, much of USAID-funded research is based on a competitive process.

Assessing the feasibility of the research activity is necessary from both a scientific perspective as well as a practical one, as there is little leeway for USAID, as a development agency, to fund efforts with little likelihood of successful adoption or application. While it is not always possible to know in advance what characteristics will determine success, the questions below suggest points that might be incorporated into new solicitation notices and are intended to make the selection process more transparent. In short, these questions seek to determine whether the research can be done and whether it should be done. They comprise four different aspects: existing level of knowledge, potential impact, context of the proposed sites, resource needs, and portfolio balance.

Knowledge/technology demand and supply

- Is there a scientific knowledge gap?

The first criterion for funding a specific research topic should be whether there is a knowledge gap that needs to be filled. The need might be to improve theory or it might be to refine an application; it might be technically-oriented or policy-related. In each case, an argument must be made that research in the topic is needed.

- Is the proposed topic seen as filling not only a scientific gap but the needs of key stakeholders? Has the research topic emerged from participatory assessments?

As emphasized throughout the report, USAID-funded research needs to be linked to development goals. Historically, there have been too many cases of research that has been carried out because it was of theoretical interest to a group of scientists, but of little practical value to those in the field. In choosing a new research focus, there should be some evidence of a consultative process, whether with regional or national level scientists and/or government officials or community members and civil society organizations, illustrating local involvement and a link between the research goals and development outcomes.

- Is the subject of interest to and already supported by other donors or the private sector?

Another criterion for selection should be whether the topic is already supported by other donors i.e., are there alternative sources of supply? In some cases, the ability to leverage funds, making the sum of the parts larger than the whole, would be a plus. In other cases, other support might be sufficient, and additional investigation by USAID would be redundant.

- Is the research within the capacity of US institutions and their partners and is it of long-term interest to them?

Is there present capacity in the US, and will the proposed effort add to ongoing research themes within partner institutions to create a win-win situation, with both domestic and international impacts?

- Does the proposed research have an appropriate upstream-downstream balance?

Basic research and applied research are both two ends of a continuum, while also linked in a more iterative process. Broad applicability of outputs requires that some of the more basic elements which define technologies or knowledge according to fit along gradients of ecosystem/environmental change in system drivers be developed and applied to facilitate broad extension along those environmental gradients. This often requires as a first step the building of conceptual models of the production ecosystem. It is most important that this be done in a collaborative mode by the research team partners, as it is used to show relationships and interaction both of elements of the ecosystem and by those researching them. Then during

the research, process-based models for the key drivers are required to be used as tools in extrapolation. Other, more specific areas of research such as application of advanced genetic tools and genetic sequences have a definite upstream dimension.

Potential impact

- Have impact pathways been identified?

Historically, there was a distinct separation between research and extension in USAID-funded research programs. This has been changing over the past few years, and has given rise to serious discussion about the best ways to manage, institutionally, the different incentives for research and for application/extension within the university setting and within the Agency. The shift to the "leader with associate" assistance model used in the last two CRSP grant agreements, which is intended to make it easier for USAID field missions to request US university assistance, reflects a desire to link research activities with their application in the field. The ultimate goal of all projects, however, is to achieve results over a range of goals including both the creation of new knowledge and the successful application of that knowledge. This requires that appropriate partnerships be in place for both applied research and eventual outreach in potential impact areas.

- Does the proposed research have the potential to create synergies or have multiplier effects with other ongoing activities?

As an additional criterion, greater weight would be given to activities that have the potential for creating new links with other activities or partners. Activities that expand scientific networks, that build national and regional databases, or that integrate several types of information in new models are possible examples.

- Will the research create knowledge or technologies (outputs) that are "public goods"?

There has been strong sentiment in the reviewed reports and in the stakeholder workshop that public funds should be used to support the creation of international public goods, i.e., "goods which are non-exclusive in access and non-rival in use, and which have application in more than one country (and probably more than one region)" (CGIAR Science Council 2005: 22). There is a range of types of international goods that can be provided. The operative question is whether the goods can be made widely available at appropriate cost. Can IP issues be solved?

Context in the target area(s)

For field-based research efforts, it is critical to determine if the conditions in the regional or national context will support the proposed work. National agricultural research programs will (and should) have widely varying capabilities based on reasonable public sector resource investment. Some will remain quite small, and focused on technology application with minimal modification. The smaller ones will require considerable help, for example, to establish systems to network and establish tools and data sets to help in their technology selection and application work as well as more general networking at the program level. To maximize chances for success, a number of local context issues should be considered in choosing to initiate a specific research activity, such as:

- Is there national government commitment to putting into place the incentives, investments, and institutions not only to support the research activity but to make the research results applicable?

The importance of good governance and an enabling environment to support the research process and to create the likelihood for its successful application have been stressed throughout this report (see especially the regional discussion on Africa). Consideration of the national governance context is therefore an important component of the decision to locate a research activity in one location over another.

- Is there commitment to the building of appropriate institutions and human resource capacity to both carry on the research as well as to implement research results? Have the proposed partners demonstrated evidence of their capabilities to participate in the research programs?

Requests for Applications (RFAs) can ask researchers to demonstrate how national governments intend to facilitate or support the research activity. Among the CRSPs, this is typically indicated through formal commitment letters from government offices and national institutions showing in-kind and financial support for the staff who will be involved in the research programs.

- Is the proposed research activity going to be able to perform under conditions of less-than-optimal governance and security? Is the proposed research topic one that takes account of conflict or insecure conditions?

These questions address both the choice of research topic as well as the operational concerns. If research activities are proposed for locations that are experiencing security problems, these conditions should be clearly identified and solutions for working in them addressed. It may be necessary to list alternative locations or strategies if conflict or insecurity requires that research be halted.

Resource needs

- Are there sufficient funds available to support the proposed activity?

The choice of a specific research activity is influenced by both its projected cost and by the level of funding available. In the constrained resource environment that agriculture and NRM research faces, it is not possible to support many "big ticket" projects. In recent years, earmarks for both the Collaborative Research Support Program and the CGIAR centers are allocated across a wide set of institutional partners and activities; a single program is unlikely to receive a disproportionately large allocation compared to others. Activities are encouraged to leverage funds from sources other than USAID.

Portfolio balance

- Does the research contribute to a desired content as well as appropriate regional distribution across the USAID portfolio?

As stated above, for USAID to be responsive at both the global level and to its own strategy, and to align its portfolio with MDG goals, its portfolio must contain elements of these interrelated components:

- Capacity (both human and institutional) to develop policies that enable growth to take place;
- Development of policies and institutions that enable growth and natural resources management to be inclusive and pro-poor;
- Policies, institutions and technologies that sustain the natural resource base; and
- Technologies (and the human and institutional capacity to develop them) that provide growth opportunities.

Individual projects, as well, must have these elements already in place, or contribute toward providing them. In addition, there is both a political and institutional need for an appropriate USAID geographical distribution of research activities.

USAID PORTFOLIO BALANCE

The seven priority areas discussed above provide portfolio balance; they address the USAID Agricultural Strategy Themes as follows in the illustrative table:

Table 4. Portfolio Balance

USAID Agricultural Strategy Priority Research Focus	Theme One	Theme Two	Theme Three	Theme Four
Creation of pro-growth environments	■	■	■	■
Human and institutional capacity-building	■	■	■	■
Creation of pro-growth environments	■	■	■	■
Modern genetic tools to support crop and animal improvement	■	■	■	■
Staple food crops in less-favored areas		■	■	
Income Diversification through high value crops, market chains	■	■		
Soil and water management		■	■	■
Resource access and broadened participation	■	■		

- Theme One: Expanding global, regional, and domestic trade opportunities and improving the capacity of producers and rural industries to act on them;
- Theme Two: Improving the social, economic, and environmental sustainability of agriculture;
- Theme Three: Mobilizing science and technology and fostering a capacity for innovation; and
- Theme Four: Strengthening agricultural training and education, outreach, and adaptive research.

ANNEX 1: SCOPE OF WORK

SUBJECT

Synthesis and assessment of agricultural research priorities for development and USAID priorities.

BACKGROUND

The US Agency for International Development (USAID) invests significant resources in agricultural research activities in support of its ongoing efforts in the economic development of rural areas in target regions of the world. Many of these resources are deployed through the Bureau for Economic Growth, Agriculture, and Trade (EGA T). These investments support a number of significant initiatives, importantly including the Collaborative Research Support Program (CRSP). In addition, pending new agricultural research activities to support the horticulture and water resources sub-sectors as well as current efforts with agricultural biotechnology and support to the CGIAR system are part of this important Agency portfolio.

USAID recently launched its new agricultural strategy: *USAID Agriculture Strategy: Linking Producers to Markets,* which identifies the mobilization of science and technology as well as strengthened agricultural research as among the Agency's priorities in the sector. Moreover, the *CRSP Guidelines* call for a periodic review and priority setting process for agricultural research activities to provide guidance to the Agency with respect to the configuration of that program. Decisions will soon need to be made regarding a number of CRSPs which are approaching 10 -year funding horizons. Urgent decisions regarding new research activities (horticulture, water) are also pending. Given this convergence of factors, the Agency needs to assess priority areas for USAID agricultural research investment to achieve the greatest impact on smallholder-oriented agricultural growth.

For purposes of this discussion, the Agency uses the broad definition for "agriculture" that is articulated in the Title XII (as amended in 2000) of the Foreign Assistance Act of 1961:

> As used in this title, the term 'agriculture' includes the science and practice of activity related to food, feed, and fiber production, processing, marketing, distribution, utilization, and trade, and also includes family and consumer sciences, nutrition, food science and engineering, agricultural economics and other social sciences, forestry, wildlife, fisheries, aquaculture, floriculture, veterinary medicine, and other environmental and natural resources sciences.

This definition sets a very broad agenda for accomplishing this assessment. The contractor is expected to address this broad definition for agriculture in conducting the assessment.

USAID is not alone in the need to set priorities for agricultural research investments. Many of USAID's partner organizations, often with USAID support, have been involved in setting research priorities at the global, regional, sub-regional and national scales. What is missing is a synthesis of these various priority-setting processes and a determination of which priorities are well-served, where there are gaps, and in what areas the US has the greatest comparative advantage in achieving impact on smallholder-oriented agricultural growth.

This Scope of Work addresses this need and calls for a competent external contractor or consultant to provide the leadership to accomplish this task in a timely fashion.

ASSESSMENT PROCESS

The Assessment Process will consist of three major components as stated below:

COMPONENT 1

The contractor will complete a comprehensive review of agricultural research priority setting processes/assessments/exercises that have been completed in the recent past at both the global and at the regional/sub-regional levels. The major global regions of interest to USAID include Africa, Asia and the Near East, Europe and Eurasia, and Latin America and the Caribbean. A non-comprehensive list of organizations/processes that should be consulted includes the Global Forum for Agricultural Research (GFAR), the Forum for Agricultural Research in Africa (FARA), the Inter-Academy Council study on African Agriculture, the UN Millennium Project Hunger Task Force Study, NEPAD's CAADP, the World Bank, and the CGIAR. Agency-led processes must also be consulted including the research priority-setting work in the Africa Bureau being led by IFPRI using the Strategic Analysis and Knowledge Support System (SAKSS) and the priority-setting work for agency investments in agricultural biotechnology. The process for conducting each priority-setting exercise analyzed, including the level of participation from stakeholders, should also be briefly described. This component of the assessment should conclude with a written document which synthesizes agricultural research priorities both globally and regionally/sub-regionally, as determined by the priority setting documents consulted. In addition, the documents consulted should be provided to USAID as an appendix to the report.

The level of specificity of the research priorities will range from the most general (e.g. water research) to priority crops/livestock issues (e.g. cassava, poultry disease management) to specific research needs (e.g. drought tolerant maize). In the synthesis, all three levels should be covered in at least some detail. The consultant should consider the need for cross-cutting research and economic, social science, and policy research. In addition, the consultant must be attentive to such related issues as institution building, public-private partnerships, policy issues, and sustainability in the context of research priority setting.

COMPONENT 2

The second part of the work will be to consider the outcomes of the agricultural research priority synthesis (Component 1) and, based on the outcome of this synthesis, determine which identified priorities are already sufficiently-covered by national research programs, international research centers, relevant USAID programs, and agricultural research efforts supported by other donors. Once the priorities that are well-covered are understood and documented, the gaps in current research on identified priority areas must be described. This component of the work will be completed with a document which describes in detail priority research areas that are not already well-covered by other programs (be they national, regional, global, funded by USAID or by other donors). This document is to be prepared as a second part of the document presented based on component 1 above.

The first two components of this process will allow USAID and its partners to understand agricultural research priorities for development as determined by a multitude of in-depth and participatory assessments completed by other relevant experts and the aspects of the research agenda that are already well supported. In addition, the completion of these two components of the process will clearly identify research agenda items that need further attention and support. These gaps will be candidates for future USAID investments in agricultural research to support its development agenda.

COMPONENT 3

Finally, in the third part of the process, a participatory process will assist USAID in the identification of agricultural research priorities. This component of the process will pro actively draw on the opinions, advice, and guidance of various stakeholders in the sector, including BIFAD, the university community, the CGIAR/IARC systems, other major donors, Congress, NGOs, government agencies (USDA, etc.), and representatives of the private sector. This part of the process will also assure legitimacy and broad acceptance for the product which results. An important part of this component of the process will be identification of the comparative advantage of USAID and its partners in addressing the identified agricultural research priorities and gaps and the probability of achieving impact on smallholder-oriented agricultural growth. Final decisions regarding the agricultural research priorities of the Agency will be made following completion of

this third component of the process. Component 3 will include, as a significant part, a stakeholder workshop in Washington convened by USAID and facilitated by the contractor.

Driving the schedule is the absence of an agreed-upon list of Agency agricultural research priorities and the need for Agency decisions by September 2005 to prepare for the competitive awarding of CRSP ME agreements in 2006 as well as possible water CRSP and some yet to be determined follow-on to the global horticulture assessment that is currently underway.

DELIVERABLE OUTCOMES OF ASSESSMENT AND PRIORITY-SETTING PROCESS

The contractor will deliver to the Agency the following items according to the schedule which follows:

- Part 1 of a document which provides a synthesis and analysis of existing agricultural research priority exercises/processes/assessments as described in the first component of the process above.
- Part 2 of the document which presents an analysis of priority research gaps (at the global, regional and sub-regional levels) that are currently not well-supported by any research entity. Components 1 and 2 should be presented as a single document according to the schedule outlined below.
- A workshop convened to consider the document described in 1 and 2 above. The contents of the document will be presented by the assessment team and then reviewed by a panel of qualified peers. Afterwards, the review document and the panel comments will be open for public comment which will be recorded and transcribed as part of the final report. As part of the final report, the contractor will incorporate a summary of these discussions.

SCHEDULE FOR ASSESSMENT AND PRIORITY-SETTING PROCESS

The proposed schedule would be as follows:

Early week of May 2 – draft outline of report and team assignments for consultation with USAID.
May 20 draft of report for review with USAID.
May 27 comments from USAID.
June 1 revised draft report to technical review panel.
June 8 public workshop.
June 24 final report.

PROPOSED TEAM AND LEVEL OF EFFORT

1. ASSESSMENT TEAM:

Team Leader: Senior Agricultural/Natural Resources Management Research Professional (25 person days for document preparation including 1 day for the workshop and 1 day for workshop preparation)

This person should have a PhD in some aspect of agricultural science or related social science area with at least ten years of development experience in the administration and /or implementation of agricultural research/natural resources management. This person should also have demonstrated ability to interact with senior development and research professionals around the world and the analytical ability to prioritize agricultural research topics based on existing assessments, studies and other relevant information. The person should have demonstrated excellent oral and written communication skills.

Two Senior Agricultural/Natural Resources Management Research Professionals (20 days per person for a total of 40 person days for document preparation including 1 day for the workshop and 1 day for workshop preparation)

These individuals should have similar but complementary experience and qualifications to the Team Leader in the identification, consolidation and written presentation of study/research results relating to international agricultural/natural resources management. These individuals should have significant demonstrated analytical ability to evaluate, summarize and consolidate existing information relating to the prioritization of agricultural research/natural resources management topics and issues. Each individual should have demonstrated outstanding written communication skills.

2. REVIEW PANEL

The review panel will consist of five (5) individuals with complementary skills, knowledge and experience at a level similar to and commensurate with individuals selected for the assessment team. Each individual will review the Assessment Team's draft report and prepare a set of written comments in a 5-7 page paper. These comments will then be summarized and presented orally during the workshop. These comment papers will become part of the official comment record and will be included in the overall final report in an Appendix prepared by the contractor due June 24, 2005. Each of the review panel members will be allocated four (4) days LOE to review the assessment report and prepare their comment reports.

3. HOME OFFICE PROJECT MANAGEMENT SUPPORT:

The contractor will provide a management support and supervisions through the Chief of Party, the Deputy Chief of Party, or a Senior Policy Advisor for up to ten (10) days who will work with the assessment team, review the assessment report and coordinate comments, coordinate the review panel, assure quality control and assurance, coordinate the workshop, and finalize the final report with assistance of the assessment team leader. The contractor will also provide up to six (6) days of junior level research assistance to support the assessment team, and up to six (6) days of administrative support for the workshop. Finally, the contractor will provide the necessary technical support to transcribe the full record of the workshop proceedings within 5 working days for use by the assessment team leader and the contractor to prepare the final report. This transcription will be made available on either a disk or as an Appendix attachment to the final report.

The contractor will finalize the location of the workshop within 10 working days of the official approval by the CTO of the assessment team.

ANNEX 2: ASSESSMENT TEAM

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ANNEX 3: BIBLIOGRAPHY OF DOCUMENT SUMMARIES

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VOLUME II:
DOCUMENT SUMMARIES

INTRODUCTION

This volume has two sections. The first section is a list of all the documents that were read and summarized for the preparation of the report. The second section provides summary statements (usually two to three pages) of each of the "key" documents. Additional documents used as reference material, but not summarized, are listed separately in Annex 4 of the main report. After the June 8th, 2005 stakeholder meeting, IRG will be preparing a resource CD containing the full-text files of the source documents.

Each summary has four parts, describing:

- First, the institutional background of the group that authored the report or other circumstances surrounding the report's preparation;
- Second, the consultation process used in the preparation of the report;
- Three, a brief section providing a general overview of the report, including, in some cases, a description of important development goals or constraints; and,
- Four, a listing of research recommendations mentioned in the report. Not all of the documents actually identify research priorities; many only suggest possible areas for research. Some only indicate topics for improvement, often in a regional context, that imply needed areas of research. The section title of "specific research recommendations" should therefore not be taken too literally.

The summaries reveal that the documents were of different levels of quality and detail. Most dealt more with development concerns than with specific research priorities. Others described on-going research, but did not necessarily explain how topics were chosen. Some documents were more political; others were more technical.

A second concern is that the documents were reviewed by different members of the team, and that there was no formula for creating the document other than the four-part outline mentioned above. Time constraints prevented a more systematic process by which the virtual team might have been able to cross-validate the summaries by having more than one reader of some of the most important documents. Another difference in the summaries is the degree to which they are excerpted from the source documents or to varying extent rewritten.

Reviewers agreed to present the material in the summaries in as objective a manner as possible.

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SANREM 2004 "Advancing Conservation and Use of Natural Resources." SANREM CRSP 2003-2004 Annual Report. Kristin R. Miller (editor) Watkinsville, GA: SANREM CRSP. http://www.sanrem.uga.edu/sanrem/database/pdf/webY6AR.pdf

DOCUMENT SUMMARIES

CIDA

Canadian International Development Agency (CIDA) 2003 "Promoting Sustainable Rural Development Through Agriculture: Canada Making a Difference in the World." Quebec, Canada: CIDA. http://www.acdi-cida.gc.ca/cida_ind.nsf/vall/ECE27220C9FA44AF85256C4D006A0B4D?OpenDocument

Institutional Background: The Canadian International Development Agency (CIDA) is the foreign assistance arm of the Canadian government. It focuses its work in four areas. The largest funding portion (43.8 percent) goes to social development; the second largest portion 32.9 percent goes to economic well-being; the third largest portion goes to governance (15.4 percent), and the smallest portion is allocated to environmental sustainability (7.9 percent). CIDA views agriculture as central to its pursuit of economic well-being, and has pledged to increase its funding from $95 million annually in 2003 to $300 million annually in 2005, reaching $500 million by 2008, a figure that (depending on the exchange rate) equals or even exceeds the USAID agricultural budget.

On May 16, 2005, CIDA announced three new initiatives and $33 million of new investments in projects to strengthen the quality, safety and marketability of agriculture and food products in developing countries, particularly Vietnam.

Consultation Process: The agricultural strategy document reflects extensive consultations with partners in Canada and overseas on the basis of a discussion paper entitled *Sustainable Rural Development: the Role of Agriculture in Canada's International Assistance*. Between October 15 and December 15, 2002, nearly 2,000 people visited CIDA's on-line forum. CIDA received submissions from more than 60 organizations and individuals. As well, CIDA consulted with its partners in developing countries through round tables and informal discussions, and received input from 12 countries. The Minister for International Cooperation chaired 12 round table sessions in Canada, as well as an international round table in Ottawa attended by developing countries, donors, and multilateral organizations. More than 150 organizations participated in these sessions led by the Minister.

The Priorities of this document have been developed within the context of the Millennium Development Goals.

PRINCIPLES OF THE CIDA APPROACH

The following five principles will underpin CIDA's programming in agriculture:

Creating new options for the poor. Agricultural productivity, which is currently low, must be steeply increased.

Empowering developing countries. At the national level, sustainable agricultural development requires strong institutions (both public and private) and an appropriate enabling environment.

Building and sharing the knowledge base. Over the years, many doomsayers have predicted that agricultural growth would fail to meet the food needs of growing populations, leading to starvation and death on a global scale. Those predictions were averted because of rapid progress in advancing and using knowledge.

Relying on partnerships. Creating the opportunities to allow the poor to escape poverty and hunger through sustainable agricultural development is an undertaking beyond the scope of any single donor.

Achieving gender equality by empowering women. Women are crucial partners in the fight against hunger and poverty. Women farmers contribute substantially as casual laborers and unpaid family workers in both commercial and subsistence agriculture, including livestock and fishing.

PROGRAM PRIORITIES

CIDA will execute its programming in agriculture in five areas. These areas, and the respective priorities under each, were determined after extensive consultations. Relevance and impact, affordability, Canada's comparative advantage, and opportunities for Agency leadership were key criteria in reaching decisions on programming priorities. Lessons learned from the Agency's long engagement with programming in agriculture have also informed CIDA's analysis.

STRENGTHENING NATIONAL CAPACITY

Programming priorities:

- Supporting sector assessment, domestic policy formulation, and strategic planning.
- Assisting developing countries to compete both regionally and in the global marketplace through enhanced capacity to formulate and implement trade policies, and to develop infrastructure and overcome trade barriers, e.g. sanitary and phytosanitary requirements.
- Building the capacity to respond to the opportunities and risks of biotechnology.
- Increasing national capacity to undertake gender analysis, manage natural resources, and respond to agriculture-related conventions and protocols.

CREATING AND USING TRADITIONAL AND NEW KNOWLEDGE FOR DEVELOPMENT

Programming priorities:

- Strengthening national, regional, and international agricultural research and transfer capabilities.
- Improving crop and livestock adaptation to stress and enhancing the efficiency of natural resources utilization.
- Increasing the food and feed value of staple crops of the poor.

ENHANCING FOOD SECURITY, AGRICULTURAL PRODUCTIVITY, AND INCOME

Programming priorities:

- Improving access, management, and administration of land.
- Diversifying and intensifying agricultural systems.
- Reducing post-harvest losses.
- Improving food safety, nutrition education, and use of available foods.

AGRICULTURAL SUSTAINABILITY AND NATURAL RESOURCE MANAGEMENT

Programming priorities:

- Reversing current trends of land degradation.
- Promoting integrated natural resource management at farm, community, and watershed levels.
- Improving the efficiency and effectiveness of water use in agriculture.

DEVELOPING WELL-FUNCTIONING MARKETS

Food markets are responding to populations that are becoming increasingly urbanized, earning higher incomes, and demanding more diverse products of higher quality and value, including livestock products, fruits, vegetables, flowers, and processed foods. Also, as food markets globalize, trade in high-value agricultural products has been growing. Increasingly, food processors in developed and developing countries are sourcing their supplies globally. If the obstacles to international trade currently faced by the poorer developing countries — subsidies, and tariff and non-tariff trade barriers — can be overcome, agricultural producers have a greater chance to participate in such trade.

Programming priorities:

- Supporting agro-based processing and rural entrepreneurship.
- Strengthening local market organizations and institutions.
- Promoting agricultural services through cooperatives and rural agricultural education.
- Promoting access of farmers in developing countries to international markets.

Table 1: Targets for CIDA's Investments in Agriculture

2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
$85M (actual)	$95M	$150M	$225M	$300M	$400M	$500M

LESSONS LEARNED OVER THE PAST THIRTY YEARS IN AGRICULTURE AND RURAL DEVELOPMENT

Lesson 1: Agricultural projects should be viewed within a broader context of rural development.

Lesson 2: Adequate knowledge of the local context (including physical, cultural, social, economical, and political factors) of the project area by project staff is a key success factor in rural development projects.

Lesson 3: Beneficiaries should be involved in project planning and implementation to ensure that the project is sustainable and answers real and urgent local needs.

Lesson 4: Organizing farmers into community or producer groups can improve their production, market, and bargaining powers.

Lesson 5: Rural development programming should involve women and youth — often among the poorest — during both planning and implementation stages.

Lesson 6: Collaboration and knowledge sharing can help build local research and policy capacities for long-term rural development.

Lesson 7: Create an enabling environment for the use of new agricultural products, techniques, and machinery so that they can be adapted to effectively meet local needs.

Lesson 8: Institutional strengthening and management information systems are necessary, but not sufficient, elements in integrating environmental sustainability in rural development projects.

SPECIFIC RESEARCH RECOMMENDATIONS:

As part of the process of building a knowledge base for programming in agriculture and rural development, agricultural research is identified as a "critical" component of the new strategy (page 3). "There is increasing fear that creation of the requisite new knowledge, and agricultural techniques of particular interest to

developing countries is lagging. CIDA will seek to respond to these concerns by investing in knowledge creation and use" (page 10).

Specific mention was made of:

- Research on technology transfer
- Research on nutrition
- Building local research capacity

NATIONAL RESEARCH COUNCIL

Committee on Science and Technology in US Foreign Assistance, Development, Security, and Cooperation, National Research Council. 2004 "Science and Technology in US Foreign Assistance: Interim Report to the Administrator, US Agency for International Development." (September 29) National Academy of Sciences study on Science and Technology at USAID. http://www.nap.edu/catalog/11137.html

Institutional Background: The National Research Council is a component of the National Academies. It is a nonprofit organization that was chartered by Congress and started in 1916 to provide scientific advice to the US government. According to the Website describing the study, the committee was supposed to prepare its report with attention to how USAID could be:

- Raising awareness outside USAID as to the significant contributions that USAID already makes to the promotion of the US government's science, technology, and health interests, while emphasizing that there is considerable underutilized potential for increasing contributions through foreign assistance efforts.
- Raising consciousness within the agency as to the benefits of developing an integrated strategy for international science, technology, and health capacity building.
- Using science more effectively for achieving specific programmatic goals and for improvements of existing programs.
- Looking beyond current program needs to broader opportunities for building international science capacity.
- Considering the role that the Millennium Challenge Corporation will play in influencing the future of development and foreign assistance in the US.
- Taking capacity-building steps by USAID and its partners.

Consultation Process: This brief letter is a preliminary statement of a larger study on the role of science (broadly defined) and technology in development assistance. It was prepared by a committee of experts of the National Research Council. The committee was co-chaired by Thomas R. Pickering (Boeing Company) and Kenneth I. Shine (University of Texas). Other members of the committee include Owen Cylke (World Bank), Lee H. Hamilton (Woodrow Wilson Center), Susanna Hecht (UCLA), Allan Rosenfield (Columbia University), Philip Smith (McGeary and Smith), Barry Worthington (US Energy Association), and Michael T. Rock (Hood College). The committee members and its researchers met with staff members of USAID, and, for completion of the final report, will also consult with staff of other US agencies, international organization, and USAID partners, both in the US and overseas.

Overview: The interim report argues for the fundamental role of S&T in development for its ability to help in achieving the overall goals of poverty reduction and economic growth, as well as the narrower technical and social objectives such as technology transfer, provision of health care, education, extension services, the development of information technologies and communication systems, and more. USAID's ability to achieve these goals depends on its ability to mobilize S&T and to determine its correct applications in countries experiencing different moments in development, as fragile states, transformational states, or threshold states (4).

The report raises the question of how to best structure USAID's support of S&T in light of the increasing involvement of other US agencies in S&T work overseas (e.g., the Centers for Disease Control, USDA, DOD, and State). It also asks what form of coordination is needed given the multiplication of players in foreign assistance, and what mechanism could best utilize the field presence of USAID. "USAID's

understanding of local knowledge, competence, and cultural values engenders a level of respect and trust with local counterparts unique amongst US government agencies" (4).

The report recommends:

- Raising the visibility and authority of S&T in the Agency;
- Identifying senior level staff to "champion" S&T within the Agency and in meetings with other US and international partners;
- Naming a new high level Science Adviser and/or creating a new a Bureau of S&T;
- Integrating a role for S&T in emerging Agency strategy papers;
- Reversing the loss of technical staff;
- Rethinking the short-term focus of many Agency projects, particularly in the area of human capacity development;
- Strengthening the Agency's evaluation capacity.

Specific Research Recommendations: The interim report does not identify specific areas for research, but it does recommend "increased attention to building research capacity in developing countries, recognizing that such capacity is more likely to be in applied research and engineering rather than in basic research" (8).

CGIAR

CGIAR Science Council Secretariat 2005 "Draft: CGIAR Research Priorities, 2005-2015" (April)
http://www.sciencecouncil.cgiar.org/activities/spps/pubs/RP0515.pdf

> *Note: This version has been approved by the Science Council and forwarded to the Executive Council of the CGIAR for consideration in its May 2005 session. It will require additional steps (including possible revision) before approval by CGIAR Members for implementation.*

Institutional Background: The Consultative Group on International Agricultural Research (CGIAR) is a strategic alliance of countries, international and regional organizations, and private foundations supporting international agricultural research systems, the private sector, and civil society. It includes 15 International Agricultural Research Centers (IARCS), and employs a range of operating modalities, including ecoregional, regional, and four Challenge Programs (CPs). Its projected budget for 2005 is $464 million, being $64 million, (16 percent) over the actual 2003 level. (CGIAR Annual Meeting; Business: item 7).

Consultation Process: The draft priorities were assembled through an exhaustive Science Council-led process of over two years. The main part of the current process has been an inductive approach of broad stakeholder consultation, scientific input through thematic, regional, and global panels, and eminent scientist panels. Inductive approaches were informed by historical trends and deductive approaches, including the longstanding modified, poverty-weighted, congruence analysis that had been the major instrument for priority adjustments in the CGIAR for over a decade. Stakeholder input began with a broad electronic consultation that reached more than 800 stakeholders, as organized by an NGO in Chile, and went widely to global lists of NGO members.

Overview:

The process was guided by three criteria:

1. Expected impact on major CGIAR goals (poverty alleviation, food security and nutrition, and sustainable management of natural resources).
2. Production of international public goods.
3. Alternative sources of supply and CGIAR comparative advantage.

PORTFOLIO TRENDS

Historical analysis shows a steady reduction in the share of the budget going to cereal crop research. In 2002/2003 forestry (14 percent) and fisheries (5 percent) had grown to anticipated levels, and productivity research had declined to 36 percent (while remaining the largest in the portfolio). Conservation of biodiversity remains at 10 percent, and capacity-building assistance to NARS remains at 22 percent. Overall budget increases have often increased absolute investments while percentages have declined. There has been gradual recent gain in the African research portion to 36 percent, with the Asian portion remaining steady at around one third. The Latin American region is at 13 percent, down from the 17 percent of the 1990s. West Asia is at 9 percent, down from 13 percent in the late 1980s and 1990s.

SPECIFIC RESEARCH RECOMMENDATIONS:

Twenty priorities have been identified, clustered into five priority areas, each with four research priorities (Table 1). The five priority areas represent globally-strategic clusters that will form the core of CGIAR research investment. These priority areas are roughly equivalent to many of the development goals of the larger development organizations. If approved, this new set of priorities is expected to lead to a sharpened focus for existing areas, the elimination of a few, and the addition of new areas directly focused on improved food nutrition and safety and on high value productivity and market availability for poor farmers. It provides a mechanism for integration of multi-dimensional approaches to complex problems. Achieving a new portfolio balance will depend on investor funding and Center response to meet their respective targets.

Priority areas 1, 2, 4, and 5 have formed the bulk of CGIAR research since its inception, but their focus and content has been sharpened. Priority area 3, the focus on high value commodities and products is largely new. This priority has been elevated as a result of stakeholder input from nearly every region served by the CGIAR as necessary to improve incomes of the poor in an environment of projected continued decline in many global commodity prices. The main expansion within priority area 3 has been the addition of fruit and vegetables as a significant research area. Additional emphasis will be given as well to livestock, fisheries and aquaculture, and forest and tree products as high value agricultural outputs.

Priority area 1 has been augmented by greater emphasis of under-utilized plant genetic resources in support of priority 3a. Priority 1c, the conservation of indigenous livestock and 1d, of aquatic animal genetic resources are new, taking advantage of new science permitting the identification and characterization of desirable traits at reasonable cost.

Priority area 2, the genetic improvement of crops, has been sharpened by focus on specific traits for tolerance to stress, and for enhancing yield potential, areas where the CGIAR maintains comparative advantage for the development of international public goods. The Generation Challenge Program is one key activity, creating a "genomics platform" for much of the work. Most variety development work has been, and will continue to devolve to country alternative suppliers, including national programs and the private sector. Priority 2c, enhancing nutritional quality and safety, represents an expanded focus, with the "Harvest Plus" challenge program being a main activity. Priority 2d is an entirely new priority, moving into genetic enhancement of selected high-value species.

Priority area 4 includes many of the programs for integration of production systems and much of the natural resources management work. Water productivity and many of the related water quality aspects are included. Aquatic eco-systems work, including aquaculture and coastal and marine fisheries work is included.

Priority area 5 has been enhanced by inclusion of more research on availability of international and domestic markets for the poor. Research on rural poverty will receive sharpened focus.

The Science Council recommends having the portfolio evolve over a three-year period to achieve an 80 percent focus on these priority areas. Regional programs and crosscutting research areas may be designed and implemented using the approved twenty areas, with any additional areas of science being added through outside partnerships. Examples of four such crosscutting programs are outlined in detail in the document. The remaining 20 percent will be made up of innovative, exploratory research in emerging areas, or specific research required of the specific mandates of the Centers.

One Challenge Program, "Building Sustainable Livelihoods through Integrated Agricultural Research for Development; Securing the Future for Africa's Children," led by the Forum for Agricultural Research in Africa (FARA), represents a major institutional departure for a region-specific program, being led by a CGIAR partner institution.

Table 2: CGIAR System Priorities 2005–2015

Priority area 1: Sustaining biodiversity for current and future generations
1a: Conservation and characterization of staple crops
1b: Promoting conservation and characterization of under-utilized plant genetic resources to increase the income of the poor
1c: Conservation of indigenous livestock
1d: Conservation of aquatic animal genetic resources
Priority area 2: Producing more and better food at lower cost through genetic improvements
2a: Maintaining and enhancing yield potential of food staples
2b: Tolerance to selected abiotic stress
2c: Enhancing nutritional quality and safety
2d: Genetic enhancement of selected high-value species
Priority area 3: Reducing rural poverty through agricultural diversification and emerging opportunities for high-value commodities and products
3a: Increasing income from fruit and vegetables
3b: Income increases from livestock
3c: Enhancing income through increased productivity of fisheries and aquaculture
3d: Sustainable income generation from forests and trees
Priority area 4: Poverty alleviation and sustainable management of water, land, and forest resources.
4a: Integrated land, water and forest management at landscape level
4b: Sustaining and managing aquatic ecosystems for food and livelihoods
4c: Improving water productivity
4d: Sustainable agro-ecological intensification in low-and high-potential areas
Priority area 5: Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger
5a: Science and technology policies and institutions
5b: Making international and domestic markets work for the poor
5c: Rural institutions and their governance
5d: Improving research and development options to reduce rural poverty and vulnerability

CGIAR CHALLENGE PROGRAMS

Institutional Background: The Global Challenge Programs were conceptualized by the CGIAR Membership as a mechanism to focus resources on global or regional problems of major significance, where solutions have the potential for making major impact on poverty and on the sustainable use of natural resources. The first "pilot round" was begun in 2001, with a competitive round of concept notes, followed by full proposals from the three top proposals. All were rated by the CGIAR interim Science Council together with panels of outside experts in the respective fields. The three were subsequently approved, and have been funded as major CGIAR global initiatives. All three have extensive Websites as primary communication portals for reports, research plans, and publications.

Consultation Process: This is a competitively determined proposal process.

1. CGIAR Challenge Program on Water and Food 2002 International Water Management Institute (IWMI) Full Proposal www.waterforfood.org

OVERVIEW:

Immediate program objectives:

- Food security at the household level.
- Poverty alleviation.
- Improved health through better nutrition, lower agriculture-related pollution and reduced water-related disease.
- Environmental security through improved water quality, and the maintenance of water-related ecosystem services.

Management: A management consortium of 19 IARCs, NARS, Agricultural Research Institutes, and NGO partners is coordinated through IWMI, with an administrative support structure.

Research approach: Field research is carried out in nine benchmark river basins in South America, Africa, Central Asia, South and Southeast Asia and China.

SPECIFIC RESEARCH RECOMMENDATIONS:

Research is clustered in five thematic areas for organization and crosscutting analysis:

Theme 1: Crop Water Productivity Improvement (at the plant, crop and field, and ecosystem levels).

Theme 2: Multiple Use of Upper Catchments (to include community organization for water use, income, risk management and improved land and water resource management).

Theme 3: Aquatic Ecosystems and Fisheries (to include policies and governance, valuation of ecosystems goods and services and improved water productivity).

Theme 4: Integrated Basin Water Management Systems (to include upstream-downstream interactions, sustainable and equitable exploitation of the water resource, urban-rural interfaces, and food production vs. ecosystem issues).

Theme 5: Global and National Water Systems (to include globalization, trade and macroeconomic policies, investing and financing, and trans-boundary issues).

2. CGIAR Challenge Program on Biofortified Crops for Human Nutrition 2002 IFPRI/CIAT Full proposal (The CP is now known as "Harvest Plus"). www.harvestplus.org

OVERVIEW:

Objectives: Harvest Plus seeks to reduce the effects of micronutrient malnutrition by harnessing plant breeding to develop staple food crops that are rich in micronutrients, a process called biofortification.

Management: The program was fully implemented in January 2004. Funding is from The Bill and Melinda Gates Foundation, DANIDA, SIDA, USAID, and the World Bank. The Program is a global alliance of research institutions coordinated by CIAT (for genetics and breeding) and IFPRI (for nutrition and policy research).

SPECIFIC RESEARCH RECOMMENDATIONS:

- Years 1-4
  - Determine nutritionally optimal breeding objectives.
  - Screen CGIAR germplasm for high iron, zinc, and beta-carotene levels.
  - Document cultural and food processing practices.
  - Determine the genetics of high micronutrient levels, and identify markers.
  - Carry out in vitro and animal studies to determine bioavailability.
  - Begin bioefficiency studies of effects on the status of humans.
  - Conduct cost-benefit analyses on alternative food-based interventions.
- Years 5-7
  - Continue bioefficacy studies.
  - Initiate farmer-participatory breeding.
  - Adapt high-yielding, conventionally-bred varieties for select regions.
  - Release new conventionally-bred biofortified varieties to farmers.
  - Identify gene systems with potential for higher increases beyond traditional breeding methods.
  - Produce transgenic lines, and test for biosafety regulations.
  - Develop a marketing strategy for the high content lines.
  - Begin production and distribution.
- Years 8-10
  - Scale up to production and distribution of the improved varieties.
  - Determine the nutritional effectiveness of the program.
  - Crops Phase 1: beans, cassava, maize, rice, sweet potatoes, wheat.
  - Phase 2: bananas, barley, cowpea, groundnuts, lentils, millet, pigeon pea, plantains, potatoes, sorghum and yams. (Pilot work is going forward with some phase 2 crops.)
  - Nutrients: iron, zinc, vitamin A.

3. CGIAR Challenge Program on Unlocking Genetic diversity in Crops for the Resource Poor 2002 IRRI/CIMMYT Full proposal (The CP is now known as "Generation") www.generationcp.org

OVERVIEW:

Program Objectives:: The Generation Challenge Program aims to create a public platform that will use molecular biology to unlock genetic diversity and put it to use in bettering crops for the world's poorest farmers. All the early applications of the CP will address drought tolerance, where better performance is most sorely needed. It is envisioned that the genetic platform created from the primary CGIAR crops can eventually be used to provide public domain (and managed public domain) materials to plant breeders in developing countries for application to a wide range of crops. By focusing on drought tolerance, crop varieties will be less risk-prone, and can potentially withstand the less-than ideal resource environments of millions of the world's small farmers.

Governance and management: The program brings together three types of partners: CGIAR Centers, NARS of developing countries, and Advanced Research Institutes. The program has a Director, and a Program Steering committee comprised of representatives of the consortium partners. It has an external Advisory Committee, comprised of eminent scientists in the field.

SPECIFIC RESEARCH RECOMMENDATIONS:

Research approach: One of the revelations of the new era of genomics is just how similar even very different species are at the level of their DNA. The genes of all major cereals, for example, tend to be strung in the same order and relative position to one another in each species. In practice, this means that knowledge gained in one species can be put to work in many others.

The CP has five subprograms:

1. Genetic diversity of global genetic resources: charged with the exploration of the genetic diversity of global germplasm collections on the twenty-two mandate crops of the CGIAR.
2. Comparative genomics for gene discovery: Focuses on developing genomic tools, technologies, and approaches to achieve an understanding of genetic principles across many significant crops in developing countries.
3. Trait capture for crop improvement: Increase the efficiency, speed and scope of plant breeding.
4. Genetic resources, genomic and crop information systems: Links and integrates information components and analysis tools into a coherent information gateway.
5. Capacity building: A major crosscutting theme of each program includes fellowships and training opportunities.

CGIAR

Varma, S. and M. Winstow. 2004. Healing Wounds: How the international centers of the CGIAR help rebuild agriculture in countries affected by conflicts and natural disasters. Consultative Group on International Agricultural Research (CGIAR) xiv + 80pp. ISBN: 92-91270153-9. www.cgiar.org

STUDY PROCESS

The study was produced by the International Center for Agricultural Research in the Dry Areas (ICARDA) and published by the CGIAR. It is based on information provided by the CGIAR Centers to the authors. Other material was drawn from Center Websites, research reports, media releases and similar sources. The study spans a 30-year history and more than 47 country interventions across Africa, Asia and Latin America. The study focus was on climatic disasters and violent conflicts, which excludes other types of disaster/strife that are nevertheless of enormous consequence to the poor, such as HIV/AIDs, crop disease and pest epidemics, and non-violent political instability.

STUDY CONTENT:

The causes of violent conflict: The "proxy" wars of the cold war period have given way to those stemming from economic, ethnic/tribal, and religious strife. They take such forms as terrorism, warlordism and gangsterism. Four main triggers have been defined:

Modernization: Reaction against rapid development that appears to create equity and cultural gaps between the rich and the poor.

Dependency: Rebellion against the subservient role perceived to be imposed upon developing countries by global capitalism.

Mobilization: Oppressive state actions trigger disaffected groups to mobilize and resist.

Stagnation: Frustration when states fail to provide ways to escape poverty and deprivation.

(Taken from de Soysa, I. and N.P. Gleditsch. 1999. *To cultivate peace--agriculture in a world of conflict.* PRIO report 1/99/ Oslo: International Peace Research Institute)

Editorial note: This summary of causes predates the September 11, 2001, terrorist attack in New York, and the triggering of wars focused on global terrorism and the threat of WMDs.

The several intervention types are covered, with principles for success and examples given in numerous countries for each type. One of the central themes running through all of the interventions is the concept of "research-for-development," or R4D. Intervention types include:

- Alleviating immediate hunger and setting food production systems on track;
- Protecting and restoring damaged agricultural biodiversity through rebuilding seed systems, (as with seed stocks and varieties in both Afghanistan and Iraq);
- Rebuilding human capacities and agricultural institutions;
- Reducing vulnerability of the poor to future conflicts and disasters; and
- Helping development agencies work more efficiently and cost-effectively.

DEPARTMENT FOR INTERNATIONAL DEVELOPMENT (DFID), U.K DOCUMENTS

Department for International Development (DFID)/United Kingdom 2005a "DFID Research Funding Framework 2005-2007." http://www.dfid.gov.uk/pubs/files/researchframework/research-framework-2005.pdf

Benn, Hilary 2005b titled "Building science and technology capacity with African partners," January 31, 2005, speech by UK Secretary for International Development. http://www.dfid.gov.uk/news/files/speeches/sossciencetech9mar05.pdf

Department for International Development (DFID)/United Kingdom 2005c "Fighting poverty to build a safer world: A strategy for security and development" (March). http://www.dfid.gov.uk/pubs/files/securityforall.pdf

Department for International Development (DFID)/UK 2005d "DFID's Draft Strategy For Research On Sustainable Agriculture (SRSA) 2006 – 2016 A Proposal For Consultation.

Department for International Development (DFID)/United Kingdom 2003a "Establishing DFID priorities for development research**,"** Workshop Proceedings (October 20).

Department for International Development (DFID)/United Kingdom 2003b "Agriculture and poverty reduction: unlocking the potential," A DFID Policy paper (December) http://www.dfid.gov.uk/pubs/files/agri-poverty-reduction.pdf

Institutional Background: DFID is the international development agency of the UK. It holds a broad mandate including international trade negotiations and international financial institutions in addition to development assistance. It provides over £145 million of direct support to agriculture and additional general funding to agriculture and rural development activities through direct budget support to developing country partners. The Central Research Department spent £82 million in 2002/2003; that amount is increasing and will exceed £100 million by 2006/2007. DFID is a major contributor to the Consultative Group on International Agricultural Research (CGIAR), and in its most recent Research Programme statements committed to doubling that support (2005a, 2005d). It also supports several research institutes and organizations like the Overseas Development Institute (ODI) in London and the Poverty Research Unit at Sussex University (PRUS) and also makes individual awards.

Consultation Process: The 2005-2007 Funding Framework reflects a process that has been going on for several years. In 2002, a review of DFID's research, "Research for Poverty Reduction," was carried out by a team composed of half DFID staff and half external experts. That report was submitted for external review and revised. During 2003, six studies were conducted or commissioned. Over 100 individuals were consulted. Individuals were also invited to comment on the DFID Website; over 400 responses were received. Three widely attended workshops were held (proceedings of one noted above). In December 2003, a draft paper was sent out for peer review and, in May 2004, it was published for public consultation.

In addition, early in 2005 a new consultation process is being initiated on a research programme focusing specifically on research for sustainable agriculture over the next decade (2006-2016), and prioritizing research relevant for Sub-Saharan Africa, especially its rain-fed production systems (2005d). Stakeholders from global, regional, and national-level organizations will be consulted in a participatory, analytical process to identify locally meaningful research priorities (2005d).

Overview: DFID (2005a) will organize two-thirds of its research funding to focus on four big research themes:

- Sustainable agriculture, especially in Africa;
- Killer diseases;
- Where states do not work for the poor; and

- Climate change.

The remaining funding will address a wide range of themes, some not yet identified. DFID also hopes to retain a "responsive programme" to provide small grants for ideas originating from researchers. They will give more effort to building developing country research capacity. They propose to give more attention to getting research into use. They have appointed Gordon Conway as a Chief Science Advisor. The former President of the Rockefeller Foundation and an agriculturalist/ecologist by training, Conway will provide continuing leadership in the area.

The proposal for developing a consultative research strategy in sustainable agriculture (2005d) identifies four components:

- Support to IARCS and the CGIAR, as well as to the National Agricultural Research and Extension Systems in developing countries that are often responsible for the uptake of IARC research;
- Support to ecoregional programs, by supporting research on common themes within a single ecoregion. Three programs in Africa and one in Asia are proposed;
- A facility to advance DFID research results through new partnerships and networks, including efforts to enhance public-private partnerships and to develop the broader application of farmer participatory research; and
- Responsive programming to link the long-term, basic research efforts supported by UK councils with the applied research needs of southern institutions.

DFID believes that supporting agriculture is a means of reducing poverty because:

- Agriculture is central to the livelihoods of the rural poor.
- It is the economic heart of most countries and the most likely source of significant economic growth.
- Growth in agriculture benefits the poor most.
- By providing affordable food, it ensures benefits to the poor beyond the countryside.
- Broad-based economic development requires prior growth and productivity gains in agriculture.

It stresses increasing agricultural production. But it also raises basic questions about what else must be done to unlock the potential. It wants to learn from the experience of others: DFID asserts that there is no international consensus of the right mix of policies or on the role that government should play in the sector. For example it recognizes that (and wants to know more about):

- Liberalization of markets have not always delivered the expected results because markets do not always function smoothly or, in some case, even exist;
- Access to assets (such as land and water) is unequal and often reflects intractable patterns of inequality.
- Poor people's decisions are often geared to avoiding risk and vulnerability rather than optimizing investment return.
- Rural finance programs, while being essential, have had a very mixed, often poor, success record.
- Some developed countries' policies have hurt the poor.

The strategy paper for security and development (2005c) notes that:

- Poor people suffer disproportionately from insecurity.

- Insecurity is a barrier to achieving the Millennium Development Goals.
- In order to achieve security and development, development resources should be focused on achieving the Millennium Development Goals:

> It would be all too easy to unravel the international consensus for aid to be used in the fight against poverty, by allowing development budgets to be diverted to tackling high-profile threats as terrorism or weapons of mass destruction. These threats affect rich and poor alike and urgently need to be addressed. But the distinct contribution of development assistance is to tackle the longer term, underlying causes of global insecurity linked to poverty and inequality (2005c).

But, aside from mention of natural resources (specific mention is made of oil and minerals, diamonds, timber, and coltan[41]), there was no mention of agriculture or rural development as a priority or a concern in the security and development strategy paper, despite the prominence of sustainable agricultural development in the research strategy.

Specific Research Recommendations: In its new Research Framework (2005a), under "Sustainable Agriculture, especially in Africa," as well as in the consultation proposal (2005d) the focus will be on Africa, but research can extend to other rain-fed areas that have not benefited from the green revolution. Three key areas are:

- Participation: Working with poor farmers to identify and tackle their key problems, which could include, for example, problems such as poor market access, or post-harvest losses, or inadequate seed varieties, or losses of up to 20 percent of livestock per year.
- Technology: Develop new technologies and practices, such as high-yielding, disease/pest tolerant varieties for the crops that poor people grow in different kinds of marginal, rain-fed areas, new cultivation techniques that conserve soil and water, and drugs and vaccines that improve the health status of poor people's livestock.
- Access: Systems which enable poor people to hear about and choose from appropriate technologies, and a better understanding of the political and institutional factors that promote or inhibit the use of new ideas.

Additional research areas include new understanding on which policies, rules, and regulations best promote economic growth that benefits the poor; new understanding on the role of production for different markets (domestic, regional, and international) in stimulating growth in a globalized world; better access to information on transport and infrastructure; and natural resource management systems that work for the poor – including some action research. Gender and education are cross-cutting issues.

Areas of research where they have yet to take a decision include renewable energy, water and sanitation.

Although some specific topics for agricultural research will be determined through consultative priority-setting with stakeholders, the consultation proposal notes that funding will be set aside for research on increasing the relevance of technical research to the poor and on ways to improve adoption – addressing not only the "what to" but also the "how to" – and also stresses the importance of human capacity building in research programs (2005d: 5, 7).

The proposal also states a desire "to ensure that research is not driven by scientific curiosity or vested interest but is demand-led and remains relevant to the needs of the poor and thereby contributes to outcomes geared towards eliminating poverty" (2005d: 6).

[41] Coltan, short for Columbite-tantalite, is a key ingredient in the power-storing parts of cell phones, nuclear reactors, Play Stations, and computer chips. Coltan is increasingly exploited in the mountains in the conflict-torn eastern Congo.

EIARD

European Initiative for Agriculture Research for Development (EIARD) 2004 "A Strategy for the European Initiative for Agricultural Research for Development (EIARD), 2005-2010" (October) http://www.eiard.org/strategic_docs.html

Institutional Background: EIARD originated in 1994 as a joint European mechanism to coordinate support to international agriculture. In 1999, the European Commission (EC) published a strategy document, "Agricultural Research for Development (ARD)" to guide EC support to developing countries in the agriculture sector, and to coordinate European agricultural research for development policies. It has recently updated its strategy, resulting in the document reviewed below.

Consultation Process: EIARD members include fifteen Member States of the European Union, plus Norway, Switzerland and the European Commission. Each member has a National EIARD Network, consisting of ARD policy makers from the relevant Ministries and government departments, and their advisers. Each National EIARD Network is coordinated by a National Contact Point. The National Networks contain a total of about 160 individuals. The ten Accession States participated in the 2003 ECG meeting as observers, and became EIARD members in 2004.

OVERVIEW:

Within a framework of contributing to the achievement of the MDGs, the EIARD identifies eight **global trends** that can be addressed by ARD:

1. Climate change
2. Globalizing trade and communications
3. Urbanization
4. Population growth
5. Environmental degradation
6. Knowledge gap between developed and developing countries
7. Growing HIV/AIDS pandemic

These trends form the backdrop for the key challenges for ARD:

- Reducing poverty, especially in SSA
- Reducing hunger, especially in SSA
- Improving food security
- Reducing "hidden hunger"
- Enhancing the sustainable management of natural resources, especially water
- Enhancing sustainable energy production
- Mitigating the effects of climate change
- Coping with the impacts of HIV/AIDS and other diseases

Although these challenges are formidable, there are also new opportunities to address them:

- A greater political recognition of the importance of ARD in development among both bilateral and multilateral donors, as well as regional organizations and national governments in the developing world.
- New technologies, such as biotechnology, that hold the promise of better solutions to old problems.
- A growing recognition that, to be successful, technology development needs to be meshed with social, economic, and policy dimensions to have impact on beneficiaries.
- A growing participatory approach to ARD.
- The emergence of greater private sector involvement.
- Treaties on genetic resources that provide greater access to germplasm collections.
- Greater capacity among partners.
- Widening market access.

SPECIFIC RESEARCH RECOMMENDATIONS:

This brief report does not identify specific research priorities within the eight challenge areas it lists. It states that EIARD members will follow five basic principles to determine their choice of activities:

1. Relevance
2. Complementarity
3. Sussidiarity
4. Partnership
5. Participation

Within those principles, it will concentrate on three strategic areas of work:

- Effective management and exchange of European ARD information in support of policy making and research partnerships/activities.
- Formulation of European positions on ARD issues, policies, and strategies.
- Facilitation of the ARD-related decision-making process by EIARD member, global, regional, sub-regional, and national organization.

FOOD AND AGRICULTURE ORGANIZATION

Food and Agriculture Organisation (FAO) 2003 "World Agriculture: Towards 2015-2030" Rome: FAO/Earthscan.
http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/005/Y4252E/Y4252E00.HTM

OVERVIEW

The report is the product of cooperative work by most technical units of FAO.[42] Projections were carried out covering about 140 countries and 32 crop and livestock commodities. Sources of productivity growth were identified and evaluated.

The world has been making progress towards improved food security and nutrition. But as of 2001, humanity is faced with the stark reality of chronic undernourishment affecting over 800 million people, 17 percent of the population of the developing countries, as many as 34 percent in Sub-Saharan Africa and still more in some individual countries.

The study predicts that this uneven path of progress is, unfortunately, likely to extend well into this century. By the year 2015 per capita food supplies will have increased and the incidence of undernourishment will have been further reduced in most developing regions. However:

- Parts of South Asia will be in a difficult position.
- Much of Sub-Saharan Africa will probably not be significantly better and may possibly be even worse off than at present. Incomes are expected to grow slowly. Numbers living in poverty are expected to rise, from 240 million in 1990 to 345 million in 2015. By then, two out of five people in the region will be living in poverty.
- Near East and North Africa will be better only because of increased imports.

In recent years the growth rates of world agricultural production and crop yields have slowed. However, the slowdown has occurred not because of shortages of land or water but rather because demand for agricultural products has also slowed, hence agricultural prices have declined. Population growth rates are slowing. Fairly high levels of consumption have been reached in many countries and diets are changing. But it is also the case that a stubbornly high share of the world's population remains in absolute poverty and lacks the necessary income to translate its needs into effective demand.

- Diets in developing countries are changing as incomes rise and urbanization expands. The share of staples, such as cereals, roots and tubers, is declining while that of fruits and vegetables, meat (especially poultry), dairy products, eggs, and oil crops is rising.[43] A growing share of wheat is used for animal feed in the industrialized countries.
- Oilseeds have seen the fastest increase in area of any crop sector while cereal area fell slightly.
- Less new agricultural land will be opened up than in the past. Only a fraction of the extra land is realistically available for agricultural use.
  - More than half the land that could be opened up is in just seven countries of tropical Latin America and Sub-Saharan Africa, whereas other regions face a shortage of suitable land.

[42] It builds on earlier publications, including FAO 1970, FAO 1981, Alexandratos 1988, and Alexandratos 1995, the last done in preparation to the World Food Summit.

[43] See Table 1 in Volume One of this report.

  - In the Near East and North Africa, 87 percent of suitable land is already farmed while in South Asia the figure is no less that 94 percent. In these regions, intensification will be the main, indeed the only, source of production growth.
  - A shift in livestock production to more intensive systems will take some pressure off dryland pastures.
  - Urbanization provides continuing competition.
  - In many places land degradation threatens the productivity of existing farmland and pasture.
- Only half of total irrigation potential in developing countries is currently in use. However, water resources will be a major factor constraining expansion in:
  - South Asia and
  - The Near Eat and North Africa.
- These regions need to achieve greater efficiency in water use.
- Yields must account for most of future crop production growth. Growth in fertilizer use is expected to slow to 1.1 percent per year.
- Deforestation is continuing but slowing.
- Further growth in the marine stock can only be modest. The single most important influence on the future of wild capture fisheries is their governance. Aquaculture will continue to grow rapidly. In all sectors of fishing it will be essential to pursue forms of management conducive to sustainable exploitation, especially for resources under common ownership or no ownership.
- Many of the environmental problems associated with agriculture will remain serious. Loss of biodiversity caused by the expansion and intensification of production, often continues unabated even in developed countries, where nature is highly valued and, supposedly, protected. Nitrogen fertilizers, although use is slowing, will continue to be a problem. Emissions of ammonia and methane from livestock could be a growing problem. No-till/conservation agriculture, integrated pest management, and integrated plant nutrient management are particularly environmentally-friendly practices that are gaining use.
- Global warming will necessitate adjustments. Current projections suggest that potential for crop production will increase in temperate and northerly latitudes while in parts of the tropics and semi-tropics, it may decline.
- Agricultural trade will play a larger role in securing the food needs of developing countries as well as being a source of foreign exchange.
- Net cereal imports by developing countries will almost triple over the next 30 years while their net meat imports might even increase by a factor of almost five.
- For other products such as sugar, coffee, fruits and vegetables the study forsees further export potential.
- The extent to which developing countries may benefit depends upon future trade negotiations and policy reforms and investments within those countries.

SPECIFIC RESEARCH RECOMMENDATIONS

The study argues that a "doubly green" revolution is needed in agricultural research.

- Goals must include increased productivity.

- But it must also aim for sustainability – minimizing or reducing the environmental impacts of agriculture – and for equity – making sure that the benefits of research spread to the poor and to marginal areas.
- More varieties and packages for crops other than the three key cereals need to be developed.
- The potential of resource-conserving approaches needs to be fully realized.
- It must be multidisciplinary.
- Areas of special importance to ecology include the interaction of plants, pests, and predators, and competition among plants and weeds.
- Plant rooting systems and the availability of nutrients and soil organic matter also deserve more emphasis.
- Biotechnology is considered to offer great promise:
- The spread of GM crops so far is geographically very limited. Just four countries account for 99 percent of the global GM crop area: the United States with 35.7 million ha; Argentina with 11.8 million ha, Canada with 3.2 million ha, and China with 1.5 million ha. The number and type of crops and applications involved is also limited: two-thirds of the GM area is planted to herbicide-tolerant crops. All commercially grown GM crops are currently either non-food crops (cotton) or are heavily used in animal feeds (soybean and maize).
- The widespread use of genetically modified varieties will depend on whether or not food safety and environmental concerns can be adequately addressed. The spread of these varieties, in the developed countries at least, has recently slowed somewhat in response to these concerns, which must be addressed through improved testing and safety protocols if progress is to resume.
- Biotechnology could have a profound effect on the future of livestock production – artificial insemination, cloning of mammalian cells, advances in understanding the genetic make-up on animals to improve disease resistance or adaptation for adverse environment conditions.
- Biotechnology has already begun to be used in fish breeding for aquaculture.

GLOBAL FORUM ON AGRICULTURAL RESEARCH (GFAR)

Global Forum on Agricultural Research (GFAR) Web home page. http://www.egfar.org/home.shtml

GFAR Secretariat 2002 "Dresden Declaration: Towards A Global System For Agricultural Research For Development" Rome, Italy: GFAR. http://www.egfar.org/documents/02_-_Meetings/Conferences/GFAR_2000/dresdecl.pdf

GFAR Secretariat 2000 Global Framework Programmes (November). http://www.egfar.org/documents/05_-_Research_Programmes_and_Global_Initiatives/Global_Partnerships_Programmes_(GPPs)_and_Facilitation_Units/Global_Framework_Programmes.pdf

GFAR Secretariat 2001 Technical Workshop on Methodologies, Organization and Management of Global Partnership Programmes: "Fostering mature partnership in technology generation and transfer: Specific role of rural communities of the Maghreq/Maghreb project." (9-12 October) Rome, Italy. http://www.egfar.org/techworkshop/aims.htm

GFAR Secretariat 2002 "Thinking the Future. Emerging Global Partnership Programs" (January) http://www.egfar.org/documents/05_-_Research_Programmes_and_Global_Initiatives/Global_Partnerships_Programmes_(GPPs)_and_Facilitation_Units/Emerging_GPPs.pdf

GFAR 2003 "Linking Research and Rural Innovation to Sustainable Development." Proceedings of the GFAR 2003 Conference, 22-24 May. Dakar, Senegal. http://www.egfar.org/documents/01_-_GFAR_at_a_Glance/GFAR_Publications/GFAR2003_Proceedings_En.pdf

Institutional Background: GFAR is a stakeholder-led initiative, operating from the offices of FAO in Rome. It serves as a neutral forum for the discussion of strategic issues in agricultural research for development (ARD). It facilitates and promotes cost-effective partnerships and strategic alliances among ARD stakeholders in their efforts to alleviate poverty, increase food security, and promote the sustainable use of natural resources.

Consultation Process: GFAR has gained momentum through its global fora, first in Dresden, Germany in 2000 and then in Dakar, Senegal in 2003.[44] The Dakar meeting was preceded by a global conference of farmer organizations and NGOs, thus increasing and strengthening the input of both groups. NARS, IARCS, Agricultural Research Institutes, and the private sector make up most of its other stakeholders.

The GFAR vision as set forth in the Dresden Declaration includes:

- Inclusive coverage of crops, livestock, fisheries, and forestry.
- Agriculture that is sustainable, equitable, profitable and competitive, with a focus on well-being of rural people.
- Diversified and flexible to cope with changing environments and needs of rural people.
- Responsive to multiple sources of innovation, traditional and modern.
- The vision implies a progressive shift toward a "holistic, knowledge-intensive agriculture, accessible to small and poor farmers."

[44] The reviewer attended both the GFAR I in Dresden in 2000, and GFAR II in Dakar in 2003

- Agricultural research that is demand driven.
- Priorities to take into account multi-functionality and regional heterogeneity of farming systems.
- Research design and dissemination should involve intended users and beneficiaries, particularly farmers.

Global Framework Programs (GFP) have been conceptualized and designed as partnerships for the realization of priority research objectives. Guidelines have been laid out for their characteristics, the prioritization of initiatives relevant to the GFP approach, and their guiding principles and management.

The regional MAGHREQ/MASHREB project of North Africa and the Near East has been presented as an example. This project has a diverse partnership of NARS, NGOs, private sector, extension services, farmers, policy makers, international centers and donors. Its element include research on the following:

- Agroecological characterization
- Property rights
- Policy
- Feed production
- Small ruminant management
- Management of rangeland
- Monitoring and adoption of impact
- Institutional strengthening

It is further linked to plant breeding, livestock genetic diversity, disease management and water harvesting research. The MM project uses a holistic, integrated natural resources management (INRM) approach.

As articulated at GFAR 2003:

> *A key responsibility of the GFAR secretariat is to assist stakeholders to further develop their constituencies. This is especially true for farmers' organizations, in view of their relative lack of a strong voice in agricultural research decision-making, and the need to redress this to make research more demand-driven, and also for NGOs in view of their large numbers and varied scope and goals.*

Following from this vision, there is a recurring theme throughout GFAR discussions on the need to promote the voice and impact of Civil Society Organizations (CSOs) of the several types in the priority-setting, conduct and extension of all agricultural research.

Regional group workshops convened for 1) Asia-Pacific; 2) Central Asia and the Caucasus; 3) Latin America and the Caribbean; and 4) West Asia and North Africa (WANA).

Recurring themes for most regions included:

- Capacity-building, including enhancing negotiation, communication and leadership skills.
- Mobilizing researchers and encouraging them to meet farmers' needs.
- Strengthening farmers' organizations (FOs) and addressing the issue of their representation and involvement in scientific research.
- Improvement of information and communications technology.

Some of the additional, region-specific items listed included for WANA included encouragement of private sector involvement in agricultural research and extension. In the Pacific region, farmer rights and interests, opening of research institutions to non-traditional researchers such as farmer groups and NGOs, promotion of the participatory research process, the need for land reforms and tenurial security, and research on natural resources management.

Overall, three new research areas that should receive special attention by GFAR included:

1. Agriculture and energy

2. Evaluation of the impact of globalization on the livelihoods of small farmers in developing countries

3. Study on the cost to developing countries of meeting the health, sanitary, phytosanitary and traceability requirements for exports of food and farm products to the markets of developed countries.

The needs as summarized by NGO stakeholders characterized a future for ARD led by small farmers and characterized by:

1. A strong focus on household food security and poverty reduction

2. Conservation of biodiversity

3. Sustainable natural resources management

4. Reduced/prevented conflicts over resources

5. Effective and inclusive partnership

6. Enhanced democratization with particular attention to social and gender equity and empowerment

7. Enhanced good governance

The NEPAD themes are: 1) Peace, security, democracy and political governance, and 2) Economic and corporate governance.

Within these themes priorities include:

- Agriculture and food security and intra-African trade
- Health and education
- Human resource development
- Environment
- Access to markets
- Infrastructure
- Science and technology
- Reversing Africa's marginalization

The five top priority areas for GFAR, summarized at the conference, were:

- Genetic resources management, biotechnology and biosafety
- Natural resources management and agro-ecology

- Commodity chains and underutilized species from production to consumption, with more attention to socio-economic research
- Policy analysis and management, and institutional development
- Sustainable financing mechanisms

INTERNATIONAL AGRICULTURAL ASSESSMENT

Steering Committee for the Consultative Process on Agricultural Science and Technology 2003 "An Assessment of Agricultural Science and Technology for Development" Final Report. International Assessment of Agricultural Science and Technology for Development. www.agassessment.org

First Plenary Meeting of the International Assessment of Agricultural Science and Technology for Development (IAASTD) 30 August – 3 September 2004, Nairobi, Kenya. Meeting Report and Annexes. www.agassessment.org

Institutional Background: This assessment is cosponsored primarily by the World Bank and FAO, with additional assistance from a range of other donors. It consists of a Steering Committee drawn from stakeholder groups that were represented at the assessment's first meeting in Ireland in 2002. The five co-chairs are: Rita Sharma (Government of India), Louis Fresco (FAO), Claudia Martinex Zulea (Colombia), Seyfu Ketema (ASARECA), and Robert Watson (World Bank).

Consultation Process: Initial meetings with a wide range of stakeholders on issues in agricultural science and technology in 2001-2 led to the first meeting of this assessment team in Dublin, Ireland (Nov 2002). Nine regional consultations were held as well as additional presentations to major research organizations (CGIAR, ASARECA, FAO, and FARA). The product of these meetings was a consensus proposal for an international assessment of agricultural science and technology for development.

Additional meetings have been held to develop the methodology for the assessment. In addition, it was decided to carry out five sub-global assessments in Sub-Saharan Africa, East and South Asia and the Pacific, Latin America and the Caribbean, Central and West Asia and North Africa, and Europe and North America (Notes from first Plenary meeting in Nairobi, September 2004).

OVERVIEW

The first document presents the proposal for an additional, international assessment that would be managed by an intergovernmental process and cosponsored by the World Bank, FAO, WHO, and UNEP, with participation from other and domination by no single institution. The effort would take a multi-disciplinary approach to address the full range of agricultural products (crops, livestock, fisheries, forests, fiber, and biomass) and services. It would assess the economic, environmental, health and social (including gender) implications of current and potential future technologies (Steering Committee 2003: 4).

It would provide multiple scenarios of agricultural production and services to 2050 to permit an analysis of whether current agricultural S&T is appropriate and whether agricultural research institutions are effective in having the best impact on:

- Reducing hunger and poverty and improving rural livelihoods;
- Sustaining the environment;
- Achieving equitable, socially and economically sustainable development; and
- Improving human health (nutrition and food safety) (Steering Committee 2003: 4).

The assessment will be conducted according to explicit principles of transparency, stakeholder representativeness, intellectual rigor, complementary to other on-going assessment, policy relevance, and incorporation of gender analysis and risk and benefit analysis. It will work towards developing a consensus on available knowledge and gaps. It will assess options for action. It will incorporate capacity-building activities and present a communications strategy (Steering Committee 2003: 12-13).

Currently, over US$35 billion is spent annually on agricultural research (Steering Committee 2003: 4-5).

SPECIFIC RESEARCH PRIORITIES

The report names a number of existing topics of agricultural research which the proposed assessment would evaluate to determine where funds would be best spent to reach the MDGs to reduce poverty and hunger. It mentions as possible topics "more productive crop cultivars and animal breeds, improved nutritional quality, reduction of yield losses due to pests and diseases, improved post-harvest practices, more sustainable land, forest, fisheries and aquaculture practices, more efficient water management, improved genetic, species, and ecosystem conservation and management techniques" (Steering Committee 2003: 8), along with food safety and alternative, indigenous technologies. It also notes the critical importance of an adequate policy environment to enable agricultural production to meet demand within a context of "equitable, environmentally, socially, and economically sustainable development" (Steering Committee 2003: 8).

With the completion of the assessment exercise would emerge identification of "public and private sector research and funding priorities" (Steering Committee 2003: 10). Four other outcomes are anticipated:

- A multi-stakeholder community
- Integrated local and institutional knowledge
- Framework of partnerships and cooperation
- Balanced short- and long-term research agendas (Steering Committee 2003: 10).

INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT

International Fund for Agricultural Development 2001 Rural Poverty Report 2001:*The Challenge of Ending Rural Poverty* Rome: IFAD. http://www.ifad.org/poverty/index.htm

Institutional Background: IFAD, with one foot in the United Nations world and one foot in the international financial institute world, is a development fund (not a bank) that addresses poverty in the poorest countries, in the poorest regions within countries, and for the poorest people within those regions. It provides approximately $400 million in loans to agriculture annually, mostly on highly concessional World Bank-criteria terms. Approximately 40 percent of lending goes to Africa. It also provides several million dollars per year in grants for research and capacity-building to research institutes, including the CGIAR and NGOs. IFAD leads the Popular Coalition.

Consultation Process: The lead author of the report was Michael Lipton of the Poverty Research Unit at University of Sussex (PRUS), England. IFAD staff prepared a concept paper and regional assessments. Lipton prepared an Issues Paper that was critiqued at a Brainstorming Workshop with IFAD staff and outside consultants. Outside consultants prepared Background Papers on various themes, which were critiqued at a workshop with IFAD staff and outside consultants. Lipton, collaborating with PRUS colleagues, was the main author of the final report.

OVERVIEW

The main message is "getting the priorities right." Three quarters of the world's poor work and live in rural areas. Notwithstanding the diversity in poverty, four aspects are considered to be of critical importance for understanding the challenges facing rural poverty reduction. First, institutions, markets, technology policy, and asset arrangements need to reflect the critical role of food staples in the livelihoods of the rural poor. Staples provide most of the poorest with work, income, consumption, and calories. Second, rural poverty reduction increasingly requires better allocation and distribution of water. Third, feasible growth alone, even in the rural sector, will in many countries not suffice to halve dollar poverty by 2015. In some very poor countries, too many people are too deeply poor. In some middle-income countries, initial inequality is too great. In such cases, achieving the poverty target requires redistributive empowerment of the rural poor through higher shares, access and control of appropriate assets, institutions, technologies, and markets. Fourth, particular groups – especially women – and methods – especially participatory and decentralized ones – merit special attention. Underlying all four themes is the fact that rural poverty reduction generally benefits from labor-intensive approaches.

The report explores four themes:

1) Access to assets, physical and financial, particularly land reform, access to water, and access to other assets and non-farm activities such as livestock;

2) Technology and natural resources for rural poverty reduction, especially biotechnology;

3) Markets for the rural poor, particularly lowering transactions costs for the poor, accessing input markets and technology, accessing labor markets, and benefiting from trade liberalization and globalization; and

4) Institutions for the rural poor, including decentralization and devolution, making financial institutions work for the poor, and partnership and participation.

Technology is seen as central in reducing rural poverty. A strong case is made for biotechnology research with the main goals of enhancing yield potential (and yield growth) in lead areas and spreading progress to neglected regions and main staples. The priority is employment-intensive but sustainable yield growth, in a context of improved transformation and recycling of water and nutrients. Low-input agriculture receives low priority. Improved land management technology is considered to have been historically slow to spread or to improve farm income. Africa's slow progress in agriculture and reducing rural poverty, compared to Asia's, is considered to have much to do with lack of water control. Major improvement in water availability, times and

management is essential for progress. Reviving pro-poor, resource conserving agro-technical progress faces problems. The central issue is how the poor can benefit more from recent technological progress. What conditions, circumstances, and policies make this possible? How far does the concentration of recent technical progress in private firms, as opposed to the public sector during the Green Revolution, make such technologies less pro-poor? How much progress in land and water management technologies needs to be achieved to complement the progress in new crop varieties? To what extent does current research consider the priorities of the poor, the demands of the complex, diverse, risk-prone dry and hilly farm systems?

SPECIFIC RESEARCH RECOMMENDATIONS

To capture regional specificities, IFAD produced assessments (largely done by its own staff) of rural poverty for each of the five regions in which it operates. Each regional strategy was reviewed within its respective region and, based on comments, revised accordingly.

EASTERN AND SOUTHERN AFRICA

Fifteen of the 21 countries in the region are classified as low income and 12 are classified as least developed countries. The majority of smallholders lives and farms on land that has medium-to-high potential for increased production.

Four fundamental thrusts are:

1) Promoting efficient and equitable market linkages;

2) Developing rural financial systems;

3) Improving access to and management of land and water; and

4) Creating better knowledge, information and technology systems.

IFAD also proposes to respond to major shocks in the region: HIV/AIDS and conflict and post-conflict situations.

WESTERN AND CENTRAL AFRICA

Poverty in the region is primarily rural. The rural poor have little or no voice in many decisions affecting their livelihoods. Conflict and HIV/AIDS have emerged as major threats. Poverty is often localized in specific regions. Gender is also an important factor.

Four fundamental thrusts are:

1) Strengthen the capacity of the rural poor and their organizations, and improve the pro-poor focus of rural development policies and institutions;

2) Raise agricultural and natural resource productivity and improve access to technology;

3) Increase rural incomes through improved access to financial capital and markets; and

4) Reduce vulnerability to major threats to rural livelihoods including conflict and HIV/AIDS.

Crosscutting approaches are: 1) investing in women; 2) enhancing participation; and 3) building indigenous knowledge.

ASIA AND THE PACIFIC

Poverty in Asia and the Pacific is a massive problem; more than two-thirds of the world's poor live in the region. The Fund will play a catalytic role in reducing this poverty by focusing on less favored areas – remote uplands and mountains, marginal coastal areas, and rain-fed areas.

Four fundamental thrusts are:

1) Changing unequal gender relations to increase women's ownership and control of assets and their effective participation in community management affairs;

2) Enhancing the productivity of staple food in less favored areas;

3) Reforming property and tenurial rights of various marginalized and indigenous peoples; and

4) Expanding the capabilities of the poor and the vulnerable through greater access to self-help, local accumulation, new skills, and technologies.

LATIN AMERICA AND THE CARIBBEAN

The largest group within the rural poor is indigenous people, followed by small farmers, and subsistence and landless laborers. There is still a marked inequality in the distribution of land, wealth and income and the region is highly vulnerable to exogenous factors, for example, globalization and natural disasters. More than 90 percent of the rural poor are concentrated in mountain slopes in subtropical zones and arid and semi-arid plateaus; humid and semi-arid tropics; subtropical valleys; and coastal plains.

Important thrusts are:

- Supporting native and minority ethnic communities;
- Eliminating gender inequalities;
- Increasing competitiveness and globalization of markets;
- Developing technology for small farmers and small rural businesses;
- Supplying effective technical assistance;
- Promoting innovative rural financial services;
- Improving development of micro-enterprises and regulation of rural labor markets; and
- Improving access to land and property rights.

Crosscutting issues are gender and sustainable agricultural production and use of natural resources. Five thematic areas of knowledge management are: 1) rural financial services; 2) decentralization and empowerment; 3) development of markets for services relevant to the rural poor; 4) indigenous people; and 5) access to dynamic regional and international markets.

NEAR EAST AND NORTH AFRICA

With the exception of Turkey, all countries in the region are net food importers. Water is the single most binding constraint on the rural poor. Land is limited. Four main themes are: 1) empowerment; 2) income diversification; 3) gender; and 4) natural resource management.

MILLENNIUM ECOSYSTEM ASSESSMENT

Reid, Walter et. al. 2005 "Millennium Ecosystem Assessment Synthesis Report" Prepublication Draft approved by the MA Board on March 23, 2005. http://www.millenniumassessment.org ; http://www.MAweb.org

Institutional Background: The Millennium Ecosystem Assessment was initiated by the UN in 2000, to assess the consequences of ecosystem change on people and to establish a scientific basis for actions to improve the sustainability of ecosystems. The process was overseen by a coordinating body composed of representatives of international organizations, governments, businesses, NGOs, and indigenous peoples. The full report consists of four working group reports summarized in this over 200-page synthesis report. The working groups covered the topics of Conditions and Trends, Scenarios, Responses, and Sub-Global Assessments. Additional technical reports were prepared for several different sub-topics related to international conventions on biodiversity, wetlands, and others.

Consultation Process: Over 2,000 researchers and reviewers in 95 countries contributed to the report and hundreds of organizations at all levels and drawing from all sectors of society contributed in varying ways to the consultation process and the drafting and finalizing of the report. The process started with the formation of an exploratory steering committee, which was replaced by a governing board and secretariat.

Overview: The report was designed to answer these original core questions: How have ecosystems and their services changed? What has caused these changes? How have these changes affected human well-being? How might ecosystems change in the future and what are the implications for human well-being? And what options exist to enhance the conservation of ecosystems and their contribution to human well-being?

The report defines ecosystem as "a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit" (2005: 9). The report addresses the interaction between ecosystems and humans, particularly the ways in which people's actions affect ecosystems and how people benefit from several types of ecosystem services, such as the following:

- *provisioning services* such as food, water, timber, and fiber;
- *regulating services* that affect climate, floods, disease, wastes, and water quality;
- *cultural services* that provide recreational, aesthetic, and spiritual benefits; and
- *supporting services* such as soil formation, photosynthesis, and nutrient cycling (2005: 9).

The report examines 24 ecosystem services, and finds evidence of degradation and unsustainable use associated with 60 percent of them. Among those most affected are those that have been used to provide food and animal feed: marine and freshwater ecosystems, temperate broadleaf forests, temperate grasslands, Mediterranean forests, and tropical dry forests. The overarching argument is that while ecosystem services fill essential needs for food, fiber, feed, and fuel, and also provide the basis of economic growth from which many benefit, those same processes can be harmful to some groups of people, creating or maintaining poverty, and over- or unsustainable use of ecosystems which will, over the longer term, be harmful to productivity, growth, and the ecosystems themselves. The report stresses that poverty and ecosystem management are interrelated, with poorer populations often being most directly dependent on ecosystem services and most vulnerable to change in the systems. "In all regions, and particularly in Sub-Saharan Africa, the condition and management of ecosystem services is a dominant factor influencing prospects for reducing poverty" (2005: 16), i.e., ecosystem degradation is a key factor in trapping people in poverty (2005: 106).

Four Main Findings (quoted from the text, 2005: 16)

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on earth.

- The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people. These problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems.

- The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals.

- The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially met under some scenarios that the MA has considered but these involve significant changes in policies, institutions and practices that are not currently under way. Many options exist to conserve or enhance specific ecosystem services in ways that reduce negative tradeoffs or that provide positive synergies with other ecosystem services.

SPECIFIC RESEARCH RECOMMENDATIONS:

Research on ecosystem services as understood in this report is only starting, with some services and systems well documented and others only minimally studied. In all cases, greater efforts are needed both to analyze existing information about the interconnected ecological and human systems and to investigate underrepresented topics and regions.

The report identifies four different future scenarios (explicitly not labeled as models) which describe possible levels of ecosystem sustainability linked to different population and economic growth conditions. The four scenarios vary according to degree of global interconnectedness and approach to sustainability:

1. "Global Orchestration" – high level of interconnectedness, a reactive approach to ecosystem management, but using economic policies emphasizing poverty reduction and investments in public goods. This scenario projects high economic growth while assuming low population growth rates.

2. "Order from Strength" – regionalization and global fragmentation characterizes this scenario, with a reactive approach to ecosystem management. Regional markets are emphasized, with low investments in public goods. This scenario projects low and decreasing economic growth, with high population growth.

3. "Adapting Mosaic" – proactive approach to ecosystem management building on a watershed approach to political and economic policy. Economic growth begins at a lower initial rate but increases over time. Population growth is high.

4. "TechnoGarden" – proactive approach to ecosystem management using innovative and technologies to improve sustainability in a highly globally connected world. Economic growth is "relatively high" and accelerates. Population growth is mid-range.

Some of the many topics listed as in need of further study include:

- Assessments of the economic value of ecosystem change on human well-being, particularly in assessing the value of non-marketed ecosystem services on human well-being, which have been shown to be higher than the value of marketed services (2005: 21, 39).

- Economic studies of alternative management strategies for ecosystems (2005: 21).

- Improving systems of measurement of the cultural and symbolic ecosystem services and of resource depletion more generally (2005: 22).
- Improving capabilities for predicting non-linear changes such as disease emergence, eutrophication and hypoxia, fisheries collapse, species introductions and losses, and regional climate change (2005: 24, 39).
- Improving understanding of how changes in ecosystems affect poor and vulnerable populations, including women, and integrating that knowledge into ecosystem management decisions. The reliance of the rural poor on ecosystem services is rarely measured and thus typically overlooked in national statistics and poverty assessments, resulting in inappropriate strategies that do not take into account the role of the environment in poverty reduction (2005: 25).
- Drylands management – as drylands comprise 41 percent of the earth's surface and are home to one-third of the world's population (2005: 26).
- Better understanding of the role of and appropriate responses to the five primary indirect drivers of change: population change (including growth and migration), change in economic activity (including economic growth, disparities in wealth, and trade patterns), sociopolitical factors (including factors ranging from the presence of conflict to public participation in decision-making), cultural factors, and technological change (2005: 32).

Among the specific sustainable practices (most of which would benefit from further research) which are identified in the report and used in the proactive scenarios to ecosystem management briefly described above are:

- Removal of restrictive trade barriers and distorting subsidies (2005: 28)
- Improving institutional and environmental governance to promote greater sustainability, including policies on ownership and access to resources, participatory decision-making, rights to resources, and addressing corruption (2005: 33)
- Payments for provision of ecosystem services (2005: 28)
- Investing in social and behavioral responses – education, population policies, consumer education, and citizens' groups – to change harmful environmental activities and reduce consumption, and empowering women's, indigenous peoples' and youth groups to participate in decisions about ecosystem management (2005: 36-7).
- Developing agricultural technologies to increase productivity while improving energy efficiency without increasing other harmful environmental consequences (2005: 38).
- Improving available knowledge about ecosystems and building more dynamic management support systems (2005: 39).
- Addressing problems in the water, nitrogen, phosphorus, and carbon cycles, such as water extraction and overuse, reducing flows of reactive nitrogen, reducing phosphorus in soils and preventing its flow to waterways and oceans, and enhancing carbon sequestration (2005: 58), some of which can be reduced through increasing wetlands (2005: 79).
- Addressing losses in biodiversity and genetic diversity (2005: 59). Losses in biodiversity affect the abilities of ecosystems to react to and/or recover from threats and damage (2005: 77).
- Improving soil quality through increasing levels of organic matter using no- or low-tillage systems (2005: 184).

The following section, "Examples of Promising and Effective Responses for Specific Sectors" (quoted from the text 2005: 34) identifies a set of possible actions to improve the sustainability of ecosystems while supporting agriculture and several of its subsectors. Although these are not listed as research topics, each topic could become the subject of research, both as a primary topic or to develop appropriate policies and/or applications. It is clear that research into how to make market mechanisms more supportive of sustainable resource use is a central underlying theme in the list.

> Illustrative examples of response options specific to particular sectors judged to be promising or effective are listed below. A response is considered effective when it enhances the target ecosystem services and contributes to human well-being without significant harm to other services or harmful impacts on other groups of people. A response is considered promising if it does not have a long track record to assess but appears likely to succeed or if there are known ways of modifying the response so that it can become effective.

Agriculture

- Removal of production subsidies that have adverse economic, social, and environmental effects.
- Investment in and diffusion of agricultural science and technology that can sustain the necessary increase of food supply without harmful tradeoffs involving excessive use of water, nutrients, or pesticides.
- Use of response polices that recognize the role of women in the production and use of food and that are designed to empower women and ensure access to and control of resources necessary for food security.
- Application of a mix of regulatory and incentive- and market-based mechanisms to reduce overuse of nutrients.

Fisheries and Aquaculture

- Reduction of marine fishing capacity.
- Strict regulation of marine fisheries both regarding the establishment and implementation of quotas and steps to address unreported and unregulated harvest. Individual transferable quotas may be appropriate in some cases, particularly for cold water, single species fisheries.
- Establishment of appropriate regulatory systems to reduce the detrimental environmental impacts of aquaculture.
- Establishment of marine protected areas, including flexible no-take zones.

Water

- Payments for ecosystem services provided by watersheds.
- Improved allocation of rights to freshwater resources to align incentives with conservation needs.
- Increased transparency of information regarding water management and improved representation of marginalized stakeholders.
- Development of water markets.
- Increased emphasis on the use of the natural environment and measures other than dams and levees for flood control.
- Investment in science and technology to increase the efficiency of water use in agriculture.

Forestry

- Integration of agreed sustainable forest management practices in financial institutions, trade rules, global environment programs, and global security decision-making.

- Empowerment of local communities in support of initiatives for sustainable use of forest products; these initiatives are collectively more significant than efforts led by governments or international processes but require their support to spread.
- Reform of forest governance and development of country-led, strategically focused national forest programs negotiated by stakeholders.

ROME FAO

Rome Declaration on World Food Security and World Food Summit Plan of Action 1998
Rome: Food and Agriculture Organisation.
http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/003/w3613e/w3613e00.htm

Institutional Background: In November 1996, the heads of state and government, or their representatives, of 186 nations and the EEC, at the World Food Summit committed to achieve food security for all and to make an ongoing effort to eradicate hunger in all countries, with an immediate view to reducing the number of undernourished people to half their present level no later than 2015.

Consultation Process: This document resulted from months of intense negotiation. Each of its many statements reflects an expressed concern of one or more countries. Nothing in the final document was objected to by any country. It is a compromise document, written by committee, and (in the opinion of the reviewer) difficult to summarize.

OVERVIEW

The following section reproduces the commitment statement and includes, as appropriate, specific research actions that were identified.

COMMITMENT ONE: an enabling political, social, and economic environment designed to create the best conditions for the eradication of poverty and for durable peace, based on full and equal participation of women and men, which is most conducive to achieving sustainable food security for all.

COMMITMENT TWO: policies aimed at eradicating poverty and inequality and improving physical and economic access by all, at all times, to sufficient, nutritionally adequate and safe food and its effective utilization

COMMITMENT THREE: pursue participatory and sustainable food, agriculture, fisheries, forestry and rural development policies and practices in high and low potential areas, which are essential to adequate and reliable food supplies at the household, national, regional and global levels, and combat pests, drought and desertification, considering the multifunctional character of agriculture

30. Research in agriculture, fisheries and forestry will be essential to achieving the sustainable food productivity increases upon which the short and long term food security of a growing world population will depend. The combination of such research, and an enabling environment, can improve food security both at national and household levels. Equity issues and equality between women and men should be given appropriate consideration when setting research agendas for the future. Research efforts should clearly focus on poverty eradication and on the creation of more environmentally sustainable agricultural, fisheries, forestry and food production systems. This research should be directed to low, as well as high, potential areas according to their specific research needs. Renewed efforts should be made to involve farmers, fishers, foresters and their organizations in setting research priorities and directions, and to make experimental findings accessible to them.

32. Objective 3.1: pursue, through participatory means, sustainable, intensified and diversified food production, increasing productivity, efficiency, safety gains, pest control and reduced wastes and losses, taking fully into account the need to sustain natural resources.

33. Objective 3.2: combat environmental threats to food security, in particular, drought and desertification, pests, erosion of biological diversity, and degradation of land and aquatic-based natural resources, restore and rehabilitate the natural resource base, including water and watersheds, in depleted and overexploited areas to achieve greater production.

34, Objective 3.3: promote sound policies and programmes on transfer and use of technologies, skills development and training appropriate to the food security needs of developing countries and compatible with sustainable development, particularly in rural and disadvantaged areas.

35. Objective 3.4: take decisive action in cooperation between the public and the private sectors to strengthen and broaden research and scientific cooperation in agriculture, fisheries and forestry in supporting policy and international, regional, national and local action to increase productive potential and maintain the natural resource base in agriculture, fisheries and forestry and in support of efforts to eradicate poverty and promote food security.

To this end, governments in collaboration with the international and scientific communities, in both the public and the private sectors, as appropriate, will:

(a) Strengthen national research systems tin order to develop coordinated programmes in support of research to promote food security. Such programmes should focus on interdisciplinary research to provide a scientific basis for policies and action to maintain the natural resource base while increasing the productivity potential of agriculture, fisheries, including aquaculture, and forestry. Appropriate attention will be given to areas that are less endowed with natural resources. Increased cooperation with the private sector will be promoted;

(b) Strengthen international research systems, in particular the CGIAR, and promote coordination and collaboration among international, developed country, and developing country institutions;

(c) Participate actively in and support international cooperation in research to promote food security, in particular in developing countries, with special emphasis on underutilized food crops in these countries;

(d) Enhance the institutional framework allowing for the full participation of all interested parties, including indigenous people and their communities, local people, consumers, farmers, fishers and foresters and their organizations and the private sector in the identification of research needs;

(e) Promote suitable systems, inter alia participatory systems, for the dissemination and extension of research results;

(f) Ensure that gender perspectives are integrated in research planning and implementation;

(g) Promote development of methods and criteria for the strengthening of integrated and policy relevant scientific knowledge;

(h) Promote research and development leading to the use, at regional, national and local levels, of appropriate technologies, relevant post-harvest and transformation techniques, and adapted plant and animal breeding that meet local needs;

(i) Promote the research needed to continue international efforts to develop, disseminate and apply climate forecast information that will increase sustainable agricultural, fisheries and forestry productivity and be of particular benefit to developing countries.

36. Objective 3.5: formulate and implement integrated rural development strategies, in low and high potential areas, that promote rural employment, skill formation, infrastructure, institutions and services, in support of rural development and household food security and that reinforce the local productive capacity of farmers, fishers and foresters and others actively involved in the food sector, including members of vulnerable and disadvantaged groups, women and indigenous people, and their representative organizations, and that ensure their effective participation.

COMMITMENT FOUR: strive to ensure that food, agricultural trade and overall trade policies are conducive to fostering food security for all through a fair and market-oriented world trade system.

COMMITMENT FIVE: endeavour to prevent and be prepared for natural disasters and man-made emergencies and to meet transitory and emergency food requirements in ways that encourage recovery, rehabilitation, development and a capacity to satisfy future needs.

COMMITMENT SIX: promote optimal allocation and use of public and private investments to foster human resources, sustainable food, agriculture, fisheries and forestry systems, and rural development, in high and low potential areas.

WORLD BANK

World Bank 2003 *Reaching the Rural Poor: A Renewed Strategy for Rural Development* Washington DC: World Bank. http://www-wds.worldbank.org/servlet/WDS_IBank_Servlet?pcont=details&eid=000094946_03092504152762

Institutional Background: The World Bank is the largest single provider of loans for rural development, including 60 percent of all agricultural lending by the international financial institutions and perhaps one-third of ODA to agriculture specifically and about 20 percent of all assistance to agriculture-related activities.

Consultation Process: This report was largely written in-house. A detailed portfolio analysis and background studies on global and regional issues, the latter written largely by outside consultants, were completed to support the strategy process. Sectoral strategies dealing with environment, forestry, water, and private sector development were reviewed. A series of regional consultations provided an opportunity for local organizations and individuals from national governments, the private sector, NGOs, and academia to contribute to the revised corporate strategy and ensured that the Bank, its clients, and fellow donor agencies were in agreement with the focus of the regional strategies. Internal and external peer reviewers provided comments at several stages in the drafting process.

OVERVIEW

From Vision to Action, the Bank's previous rural development strategy that was launched in 1997 may have had an influence on global thinking but it also had disappointing results on the ground. In 2001, lending for agricultural projects had reached its lowest levels in the World Bank's history. The new strategy expanded and refocused directions, shifting the emphasis from:

- A narrow agricultural focus to a broader policy context – including global factors;
- A focus on crop and livestock yields to market demands and incomes;
- Staples to high-value crops;
- Primary production to the entire food chain;
- A single farm type approach to heterogeneity;
- Public to public-private partnerships, including community-driven development; and avoidance of issues to a head-on approach (biotechnology, forestry, water).

The strategy is comprehensive and inclusive. The strategy has five main components:

The strategy is comprehensive and inclusive. The strategy has five main components:

- Fostering an enabling environment for broad-based and sustainable rural development
  - OECD trade and domestic policy reform.
    - OECD trade and domestic subsidy policy.
    - Policy bias against agriculture in many developing countries.
    - Large potential gains from agricultural trade liberalization.
  - Creating a domestic policy framework to stimulate rural development: the unfinished agenda.
    - Improving the macroeconomic context.

    - An enabling policy environment for agricultural trade and market access.
    - Supporting effective markets for inputs and services.
    - Legal and regulatory frameworks that facilitate private enterprises.
    - Continuing land reforms and improving land administration.
  - Developing effective rural financial services.
  - Supporting effective institutions and good governance.
    - Improved, but still adequate, governance.
    - Administrative decentralization and development of effective institutions.
  - Fiscal decentralization.
    - Political decentralization.
- Enhancing agricultural productivity and competitiveness
  - Sustainable intensification through the application of science.
    - The challenge of biotechnology.
    - Promotion of environmentally sustainable pest management systems.
  - An evolving concept for agricultural extension.
  - Increasing the productivity of water use in agriculture.
  - Promoting diversified and sustainable production systems for expanding markets.
  - Strengthening farmer-to-market linkages.
  - Enhancing competitiveness and food safety through quality assurance.
  - Differentiated Strategies to fit various farm types: the transition to commercial farming.
  - Development of rural physical infrastructure and infrastructure services.
- Fostering non-farm economic growth
- Improving social well-being, managing risk, and reducing variability.
  - Improving access to nutrition and health.
  - HIV/AIDS.
  - Increasing access to and improving the quality of rural education.
  - Managing and coping with household food security and risk (information, insurance, contract marketing, income diversification)
  - Social inclusion, gender and ethnicity.
- Enhancing sustainable management of natural resources

– Reducing land degradation.

– Improving water management.

– Promoting sustainable production of forest products while protecting the environment.

– Supporting sustainable fisheries resource management.

– Incorporating global warming into rural planning.

The last three sections are considerably shorter than the first two, especially shorter than the second section.

SPECIFIC RESEARCH RECOMMENDATIONS

Sharper priorities appear in action plans for six different regions. Each has a poverty reduction focus and a multi-sectoral approach with increased emphasis on the private sector yet each has different priorities:

AFRICA

General improvement in the 1990s masks wide disparities in the performance of countries throughout the region. During the 1990s, only 12 of the 48 countries were able to maintain agricultural growth rates of 4 percent or better. About 100 million Africans, a fifth of the region's total population, live in countries immersed in civil or international conflict or unrest with sharply rising poverty.

Major emphasis is on the institutional foundation for reducing rural poverty. It advocates support for government efforts to decentralize and enhance the participation of rural communities. Focus is on:

- Making governments and institutions work better for the poor (decentralization, participation, voluntary producers' organizations);
- Promoting widely-shared growth (policy and regulatory reforms, research and extension, infrastructure, financial services, water control systems);
- Enhancing management of natural resources; and
- Reducing risk and vulnerability (alternative coping mechanisms, HIV/AIDS, sharing risks and costs of adopting new technologies).

EAST ASIA AND PACIFIC:

The region has undergone an unprecedented technological and economic transformation in recent years. But serious problems remain, particularly in maintaining the progress and extending it to rural populations.

Emphasis in on financing programs that directly attack poverty through targeted productivity – enhancing investments in very poor areas. The focus is on:

- Reducing rural poverty (directly attaching poverty through targeted, productivity-enhancing projects such as community development projects, and projects that enhance productivity and create non-farm employment such as water management schemes, storage and processing facilities for agribusiness, and research);
- Stimulating rural economic growth (projects and reforms that encourage private sector investment such as establishing or improving rural schools, healthcare, electricity, telephones, and roads; local governance);
- Providing food security (targeted safety nets); and
- Supporting natural resource management.

SOUTH ASIA:
Focus is on:

- Enhancing human and social capital development in rural areas;
- Facilitating rural and non-farm growth and competitiveness (including decentralization);
- Fostering efficient, sustainable, and equitable use of water resources; and
- Improving natural resources and environmental management.

***Latin America and the Caribbean*:** The approach for the LAC region puts special emphasis on rural and urban dynamics and adopts a Local Economic Development approach to addressing rural development built around increased participation of local and sub-national governments, private sector, and organizations of civil society. The focus is on:

- Enabling factors (supportive macro-economic and trade environment; new "institutionality" for sector and good governance; credible regulatory framework).
- Lines of action (raise productivity and competitiveness; competition in markets; "rural space" approach and regional development; sustainable natural resources; risk management and safety nets).

MIDDLE EAST AND NORTH AFRICA
Water availability is crucial to all agricultural systems; variability and thus, vulnerability, varies significantly across production systems. The focus is on:

- Rationalizing water management and policies;
- Improving access to social and economic infrastructure; and
- Facilitating agricultural growth and competitiveness.

EUROPE AND CENTRAL ASIA
This region focuses on sustaining rural productivity growth and the completion of the transition process in rural areas. The focus is on:

- Increased agricultural productivity and value-added;
- Off-farm rural enterprise growth;
- Development of physical and social infrastructure;
- Improved land, water, and forest management; and
- Risk mitigation.

Major gender concerns across the regions are women's literacy, lack of access to social services, economic infrastructure, and resources.

Regarding the subject of "International Agricultural Research," the Bank's current support for the CGIAR is being broadened to a multi-stakeholder initiative, including private industry, advanced research institutions, international research institutes, national agricultural research systems, and civil society. The Bank proposes to progressively allocate its contribution to up-stream research on global public goods, prioritized by share- and stake-holders, and carried out by a consortia of the most competent institutions, under the leadership of the CGIAR. The Bank also will emphasize 1) understanding and supporting policy adjustments in agricultural practices and technology as a consequence of anticipated impacts of global climate change and 2)

understanding women's role in agriculture to make agricultural research more relevant to women and other resource poor farmers.

UN MILLENIUM PROJECT

UN Millennium Project 2005 "Halving Hunger: It Can Be Done" Pedro Sanchez and M.S. Swaminathan (Coordinators). Task Force on Hunger. London, UK and Sterling, VA (USA): Earthscan. http://www.unmillenniumproject.org/documents/Hunger-highres-complete.pdf

Note: Referenced as UN2005a.

Institutional Background: This is one of 13 reports under the general direction of Jeffrey Sachs.

Consultation Process: The Task Force Coordinators are both agricultural researchers/research administrators, Pedro Sanchez and M.S. Swaminathan. There are 29 additional members of the Task Force, representing a wide range of disciplines and countries. Ten other individuals are noted as having made major analytic contributions. Fifteen papers were commissioned. Extensive e-mail communication is noted. Field work was carried out in Africa and Asia. Regional consultations were held in Asia and Africa. Draft portions of the report were widely vetted.

OVERVIEW

Three kinds of hunger are identified – acute, chronic, and hidden. Causes identified included poverty, low food production, mother's lack of education, poor water, sanitation and health factors, and climatic shocks. The hungry were identified as the poor and vulnerable. The largest numbers were found to be in Asia but largest proportion of total population and less progress was found in Africa.

SPECIFIC RESEARCH RECOMMENDATIONS

The report is organized around seven priority areas and 40 interventions. Highlights, with particular relevance to research, include:

GLOBAL-LEVEL INTERVENTIONS

To move from political commitment to action.

NATIONAL-LEVEL INTERVENTIONS

To reform policies and create an enabling environment.

The Task Force recommends that African governments invest at least ten percent of their national budget specifically in agriculture, in addition to making necessary investments in rural energy, infrastructure, health, education, and conservation of natural resources important for food security.

Agricultural research is recognized as having been a major driver of hunger reduction. The task force recommends doubling investments in national research to at least two percent of agricultural GDP by 2010. They also recommend that donors increase funding to the CGIAR to $1 billion by 2010.

COMMUNITY-LEVEL INTERVENTIONS

- Increase the agricultural productivity of food-insecure farmers.
  - Improve soil health.
  - Improve and expand small-scale water management.
  - Improve access to better seeds and planting materials. The report supports both conventional breeding and transgenic research with appropriate biosafety measures. Emphasis should be on rain-fed areas and on helping food-insecure producers sustainably increase and stabilize production. Tolerance to such stresses as drought, salinity, poor soil fertility, pests and diseases will benefit farmers in more marginal areas. Early maturing varieties are especially useful in drought-prone areas. Exciting progress is noted in developing dual-purpose food/feed crops that enable farmers to diversify into livestock production without jeopardizing their short-term food security.

  - Diversify on-farm enterprises with high-value products. Livestock, farm trees, aquaculture, and vegetables are noted as attractive options for small-scale farmers to diversify their diets and sources of income–and for improving the stability and sustainability of farming enterprises. Milk production and smallholder timber are also noted.
  - Establish effective extension services.
- Improve nutrition for the chronically hungry and vulnerable.
- Reduce the vulnerability of the acutely hungry through productive safety nets. One suggested intervention is to build and strengthen national and local early warning systems, including advances in climate prediction as the hotspot level.
- Increase incomes and make markets work for the poor.
  - Invest in and maintain market-related infrastructure.
  - Develop networks of mall rural input traders.
  - Improve access to financial services for the poor and food-insecure.
  - Provide a sound legal and regulatory framework.
  - Strengthen the bargaining power of rural and urban poor in labor markets.
  - Ensure access to market information for the poor.
  - Promote and strengthen farmers' and community associations.
  - Promote alternative sources of employment and income.
- Restore and conserve the natural resources essential for food security.
  - Help communities and households restore or enhance natural resources.
  - Secure local ownership, access, and management rights to forests, fisheries, and rangelands.
  - Develop natural resource-based "green enterprises."
  - Pay poor farmers for environmental services they provide.
- Not every intervention will be appropriate to every country or district. An important step at the national level will be to identify the priority interventions for the conditions that prevail locally:
  - Low food production caused by insufficient agricultural productivity is likely to be the primary reason for hunger in tropical Africa and remote parts of Asia and Latin America.
  - Poverty is considered to be the primary reason for hunger in South and East Asia, Latin America, Central Asia, and the Middle East.

UN MILLENIUM PROJECT

UN Millennium Project 2005 "Environment and Human Well-being: A Practical Strategy." Y.K. Navarro, Jeff McNeely, and Dan Melnick (Coordinators). Task Force on Environmental Sustainability. London, UK and Sterling, VA (USA): Earthscan. http://www.unmillenniumproject.org/who/task06.htm

Note: Referenced as UN2005b.

Consultation Process: The Task Force included 22 members. Two public events were held in conjunction with international meetings: the annual meeting of the Society for Conservation Biology (New York, NY Aug 2004) and the IUCN World Conservation Forum (Bangkok, Thailand Nov 2004). "In all, nearly 100 experts had direct input into the deliberations of the Task force on Environmental Sustainability." No mention is made of input from other than the task Force and the attendees at the two professional meetings.

OVERVIEW

The report gives significant coverage to:

- The drivers of environmental change.
- Assessing the state of the environment.
- Identifying people's dependence on it.
- Identifying the obstacles to ameliorating environmental degradation.

THE PROBLEM

The world's poor depend disproportionately on ecosystem services to provide for their systems of small-scale agriculture, grazing, harvesting, hunting, and fishing. Without access to infrastructure providing safe drinking water, electricity, fuel, and transportation, poor people rely on natural sources of clean air and water, fertile soil, renewable energy, and biodiversity to meet their needs. Although 1.3 billion people live on marginal lands and one-fifth of all people lack access to safe water, the need for environmental sustainability is not adequately addressed in most countries' poverty reduction strategies.

While all regions face the global problems of climate change, biodiversity loss, and fisheries decline, each region faces distinct immediate concerns, and overall progress toward environmental sustainability varies considerably.

- In Latin America, home to half the world's species of plants and animals, the most pressing issues are deforestation, pollution, and damage to coastal and marine ecosystems.
- In small island developing states, including Caribbean and Pacific islands, key problems are climate change, marine ecosystem health, alien invasive species, and pollution.
- In Sub-Saharan Africa, the major environmental issues are soil and land degradation, depletion of forests and freshwater resources, and poor indoor air quality.
- The Middle East and North Africa suffer most from declining per capita water resources, loss of arable land, pollution-related health problems, and weak environmental institutions and legal frameworks.
- South Asia's most pressing environmental problems are freshwater scarcity and pollution, and soil and land degradation, whilst in Central Asia they are land cover change and freshwater degradation.
- East and Southeast Asia suffer mostly from soil and land degradation, deforestation, and poor urban air quality

Drivers of change: The agriculturally-related drivers include land cover change, over appropriation or misuse of resources, invasive alien species, and pollution from agricultural wastes. Climate change can be a major factor. A range of indirect drivers are identified, including demographic change, economic factors, market failures and distortions, scientific and technological change, institutional gaps and sociopolitical factors. Agricultural production systems are a major factor, and when driven by extreme poverty, prevent people from reinvesting.

Obstacles to change: These very much parallel the drivers.

Suggested solutions: These include a range of needs. One of the keys for agriculture is to implement an ecosystems approach to agricultural production systems. The Task force recommends increasing the use of sustainable agriculture techniques to preserve natural assets, restoring and managing desertified lands, and protecting surrounding habitat. The report specifies approaches to agricultural production systems, forests, fisheries and marine ecosystems, and freshwater resources and ecosystems. Both direct and indirect solutions are offered. The roles of several of the key players are outlined, with civil society being critical.

SPECIFIC RESEARCH RECOMMENDATIONS

- Improve small-scale agricultural production systems
  - Increase the use of sustainable agriculture techniques
  - Restore and manage desertified lands
  - Protect surrounding natural habitat
- Promote forest management for protection and sustainable production
  - Increase real income in informal forest sector activities by at least 200 percent
  - Integrate ecosystem management of 90 percent of river basin systems
  - Protect and restore representative areas of all major ecosystems
- Combat threats to freshwater resources and ecosystems
  - Reduce demand for freshwater, especially in cropping systems
  - Minimize pollution levels in surface water and groundwater sources
  - Maintain aquatic biodiversity by ensuring minimum environmental flow
- Address the threats to fisheries and marine ecosystems
  - Implement an ecosystem-based approach to fisheries management
  - Restore depleted fish population levels to at least minimum target levels of biomass
  - Establish a network of representative, fully protected marine reserves
- Address the drivers of air and water pollution
  - Reduce exposure to toxic chemicals in vulnerable groups
  - Significantly reduce the under-five mortality and morbidity rates caused by pneumonia and acute respiratory infection
  - Significantly reduce the under-five mortality and morbidity rate caused by waterborne diseases

  - Reduce the atmospheric levels of the six key pollutants and methane
- Mitigate the anticipated effects of global climate change
  - Invest in cost-effective and environmentally sustainable energy
  - Promote and engage climate-friendly carbon and technology markets
  - Mainstream responses to climate change and variability
- Strengthen institutions and governance
  - Train, recruit, and retain environment experts
  - Secure sufficient funding for environmental institutions
  - Reform governmental institutions and improve interagency coordination
  - Improve governance and gender equality
- Correct market failures and distortions
  - Account for the cost of environmental degradation in national accounts
  - Introduce payments for ecosystem services
  - Reform tax structures
  - Phase out environmentally harmful subsidies
  - Develop trade regulations to promote legal, sustainable harvesting of natural resource products
  - Strengthen property and land-tenure rights
  - Improve national and international regulatory frameworks
- Improve access to and use of scientific and indigenous knowledge
  - Mobilize science and technology on a national scale
  - Establish mechanisms for science and technology advice to policymakers
  - Train civil servants and political decision makers in environmental management
  - Provide public access to information
  - Improve extension training and services so that they are based on locally-derived solutions
  - Strengthen global scientific assessments
- Build environmental sustainability into all development project proposals
  - Ensure that all project proposals and poverty reduction strategies submitted to funding agencies include an assessment of their environmental impacts
  - Establish a system of targeted incremental funding of national environmental programs
  - Increase funding to countries in support of implementing existing multi-lateral environmental agreements

UN MILLENIUM PROJECT

UN Millennium Project 2005 "Innovation: Applying Knowledge in Development." Juma, Calestous and Lee Yee-Cheong (Coordinators) Task Force on Science, Technology, and Innovation. London, UK and Sterling, VA (USA): Earthscan. (http://www.unmillenniumproject.org/reports/reports2.htm)

Institutional Background: The Millennium Project is an activity commissioned by the United Nations Secretary-General, directed by his Special Advisor on the Millennium Development Goals, Jeffrey D. Sachs. A total of 13 independent reports were prepared, each authored by a team of international topic specialists, development practitioners, and government officials, as well as other representatives from a range of civil society organizations, to propose ways to achieve the MDGs.

Consultation Process: The 40+ task force members and researchers engaged hundreds, if not thousands, of academic, development, and government organizations and individuals in the process of preparing its report. Early drafts were shared at a range of workshops with reviewers from the scientific and donor communities.

OVERVIEW

The report argues for the key role of science, technology, and innovation both historically in helping to achieve a reduction in poverty and improvements in economic growth worldwide, as well as in helping to achieve the MDGs in the future. It takes the position that, unlike an older, more linear view of technology transfer in which countries at similar income levels used similar strategies, in today's world and the world of the future, a multiplicity of strategies can be identified and drawn upon by national governments.

The report does not separately address the role of S&T in agriculture or any other sector. It looks instead to a broader level, supporting the development of "platform (or generic) technologies," i.e., those that have the widest applicability in a host of sectoral and sub-sectoral situations, such as biotechnology, nanotechnology, and ICTs. The focus on platform technologies is one of six overarching targets:

- Platform technologies
- Infrastructure
- Higher education in science and technology fields
- Government policies to promote business in S&T and innovation
- Improving governments' access to S&T and innovation advice, and
- Improving governance of global technology (UN 2005c: 2-12).

The approach advocated in the report is a dynamic and interactive one, where technological development – whether applications of existing ones from elsewhere, or newly created ones – is both encouraged by appropriate policies and then shapes new policies. "Technological innovation is therefore not simply a matter of installing devices, but of transforming society and its value systems" (Sagasti 2004 in UN 2005c: 15). Or, "[E]ducating women in the sciences is not simply a matter of meeting international obligations related to equality, it has a practical purpose of changing social attitudes and preparing the next generation to adapt to changing world conditions" (Everts 1998 in UN 2005c: 16).

Below these broad statements, the report acknowledges that the choice of specific technologies and the pathway of technological change will be site-specific or industry/sectorally specific, and closely linked to the institutional arrangements that can facilitate it. Technology cannot be considered in isolation from the policies and institutional environments in which it is created and/or applied, nor can particular technological solutions, such as increasing yields, improving soil management, or creating more efficient irrigation systems "solve the challenges of poverty and hunger: they need to be part of an integrated strategy aimed at

improving overall human welfare" (UN 2005c: 22). "Technology is a knowledge system, not simply physical technology and equipment" (UN 2005c: 33).

Four facts are affecting technology creation, diffusion, and use that differ from in the past:

1. Increasingly globalized production networks that depend upon geographically dispersed sites to produce a single product;
2. Countries have differential access to markets for new technologies.
3. Changing intellectual property regimes.
4. Revolutions in ICT and biotechnology (UN 2005 c: 25).

SPECIFIC RESEARCH PRIORITIES

Despite the emphasis on more general themes, some specific research areas are noted, although not necessarily with respect to agriculture/NRM only, but some of the more directly applicable areas of research are noted here (UN 2005c: 22-23, 48)

- Utilizing scientific and indigenous knowledge for managing complex ecosystems.
- Addressing micronutrient deficiencies.
- Water delivery and treatment.
- Water productivity – reducing the amount of water needed to produce a unit of food.
- Drought tolerant crops using both conventional breeding and genetic engineering.
- Process of technological innovation itself (page 26).
- Bringing together technology policy and industrial policy (page 48).
- The platform technologies:
  - ICT;
  - Biotechnology, e.g., bioremediation to use biological agents to clean the environment, recombinant vaccine development, nutritionally enriched genetically modified crops (like Vitamin A-enriched golden rice or the protein-enriched potato);
  - Nanotechnology, e.g., in water treatment, energy storage, food processing and storage, vector and pest detection and control, and agricultural productivity enhancement, and improving environmental management) (page 70-71, 74).

A World Bank-Rand Corporation study created a four part typology of countries and levels of scientific achievement: Scientifically advanced; scientifically proficient; scientifically developing; scientifically lagging (UN 2005c: 30). The four types form a framework for organizing various scientific activities: research collaboration, teaming for capacity building, joint research, technology transfer, funding and investment priorities, and the productivity and effectiveness of aid (UN 2005c:30).

"Collaborative research is shown to contribute most to capacity building, for example, when the subject is tied to a problem or issue to which the developing country has direct experience and some indigenous capacity exists" (UN 2005c:30).

"Investing in research on underfunded issues of relevance to developing countries is particularly important in fields such as agricultural production, environmental management, and public health" (UN 2005c: 129).

Bilateral donors can 1) increase their own support to R&D; 2) join together with other donors to support groups such as the CGIAR; and/or 3) fund "teams proposing to conduct world-class research that focuses on local or underrepresented research activities" e.g., the CGIAR challenge programs in water, biofortification, and genomics (2005c: 130).

UNITED STATES

United States [2002] "The US Position Paper for the World Food Summit: five years later" Washington, D.C. (May 29) http://www.fas.usda.gov/icd/summit/wfsposition.pdf

Consultation Process: This paper was drafted over a several-month period by a core group from USAID, State, and USDA but was cleared through an inter-agency process that ended with the White House.

OVERVIEW

The core element to assist developing countries in achieving food security is to promote agricultural productivity, especially within the least developed countries, with attention focused where the problem is most severe: South Asia and, especially, Sub-Saharan Africa.

Increased actions are proposed in six areas. Those that involve research or have research implications include:

IMPROVING POLICY FRAMEWORKS

- Conflict prevention and resolution mechanisms that provide the environment necessary to pursue food security.
- Democracy and governance based on the principles of accountability and transparency in public institutions and the rule of law.
- Policies, with particular relevance to the agricultural sector, that:
  - promote a legal, regulatory and judicial framework that ensures that private markets operate competitively and without distortions;
  - ensure rights to asset ownership and transfer are effective and nondiscriminatory;
  - provide an efficient and effective tax administration that can tap increased economic flows generated by development efforts;
  - promote trade liberalization within the context of the multilateral system;
  - respect principles of sustainability;
  - promote gender equality; and
  - help to protect the natural resources and ensure safe food and water.

IMPROVING AGRICULTURAL SCIENCE AND TECHNOLOGY

- Agricultural research through:
  - The Consultative Group for International Agricultural Research (CGIAR) international agricultural research centers.
  - Regional agricultural research organizations and networks in Africa and South Asia.
  - Increasing interaction of US agricultural, fisheries, and social scientists with scientists at universities and national agricultural research systems in low-income, food-deficit developing countries and at the international agricultural research centers.
  - Increasing the availability of biotechnology applications that address developing country food needs and agro-ecosystems, particularly addressing biotic and abiotic stresses and micronutrient bio-fortification, involving both public and private partners and building the capacity of developing country governments

and scientists to manage the regulatory, intellectual property and research management issues associated with biotechnology.

- Application of improved technologies and practices to reduce the gap between knowledge systems and technologies available to agronomists, plant breeders and farmers in developed and developing countries through:
  - Accelerating the roll-out of applied production packages developed by international and national research institutions, in partnership with other public institutions, the private sector, and NGOs.
  - Improving access to information necessary for boosting production using radio and other communications technologies to disseminate information and ideas on agricultural technologies, markets, and investors.
  - Using technologies and agricultural methods that help to protect natural resources thus assuring the long-run sustainability of agricultural productivity.

DEVELOPING DOMESTIC MARKET AND INTERNATIONAL TRADE OPPORTUNITIES

- Improving domestic market opportunities through:
  - Effective functioning of markets for inputs and products.
  - Technologies and practices that reduce food waste and post-harvest losses.
  - Fortified and other nutritious foods as value-added products in commercial markets.
  - Efficient internal storage and distribution systems.
- Improving international trade opportunities through:
  - Policy analysis that would illustrate for governments the opportunities that could result from opening their markets more widely to regional and global trade.
  - Negotiating further liberalization of agricultural trade in the WTO negotiations.
  - Policy analysis and project assistance to strengthen the capacity of the business development services sector as well as agricultural producers to respond to domestic, regional, and global trade opportunities.
  - Sanitary, phyto-sanitary (SPS) and hazard analysis and control points (HACCP)/food safety issues.
  - Science-based standards for trade in food and agricultural products and inputs, including providing support to develop animal, plant, and human health measures based on international standards and sound science.

SECURING PROPERTY RIGHTS AND ACCESS TO FINANCE

Asset distribution shapes broad-based progress because it determines the spread effects, that is, the multiplier, of economic stimulus. It is also important because it contributes to empowerment, hence participation and ownership, by the larger proportion of the rural population. Efficiency and economic growth improve when the poor get a larger share of asset control or benefits.

- Improving security of property rights through building capacity to establish effective land and water policy and administration systems – especially for women and other marginalized groups – including promoting efficient registering, titling, and surveying of land holdings; improved legal, institutional, and market infrastructure and rule of law; and the formalization of customary and communal use rights in ways that are transparent, enforceable, and consistent with community interests.

- Improving access to finance in developing countries through:
  - Creation of a conducive macroeconomic environment for rural finance.
  - Appropriate policy and regulatory framework, including the legal environment, regulatory rules and procedures, property rights and judicial procedures for institutional reform of rural and agricultural development banks.
  - Innovation in the development of micro-finance products (savings, insurance), business development services, and lending techniques that can help poor individuals, especially women, to better manage risks and their vulnerability to external shocks.
  - Improved and reduced transactions costs for remittance transfers.

ENHANCING HUMAN CAPITAL

- Higher education through:
  - Developing country university faculties of agriculture and business to carry out both education and research functions.
  - US universities in training agriculturalists at the graduate and post-graduate levels.
- Basic education, especially for girls, women, and other under-served populations, through a range of activities including improving education strategies, resources, and programs, addressing the social and cultural constraints to girls' education, getting more children into school, and improving financial accountability.
- School feeding programs to link nutrition and education and to improve attendance and performance, especially for girls.
- Improved, effective, and sustainable responses to reduce HIV transmission and to mitigate the impact of the HIV/AIDS epidemic, with particular emphasis on Africa.
- Improved health by:
  - Reducing deaths from infectious diseases.
  - Increasing the use of cost-effective key child and maternal health and nutrition interventions.
  - Increasing the use of voluntary practices to reduce fertility and improve reproductive health.

PROTECTING THE VULNERABLE

The challenge is to support governments and civil society in implementing strategies that reduce vulnerability in the short-term and eliminate conditions that create vulnerability over the long-term.

- Climate and other information for early warning to mitigate climate-related impacts, such as droughts, floods, and extreme climate events, and capacity to forewarn of civil strife and to enable host governments and non-governmental organizations to use these tools for their own planning and management of both public and private programs that cushion the social impacts of unforeseen events.
- Timely, appropriate, and adequate assistance, including through emergency food aid programs, international disaster response, and social safety nets, integrating these resources into overall development strategies through:
  - Monitoring, maintaining, and rehabilitating the nutrition and food security of persons affected by disasters.

  - Targeting the neediest and limiting possible negative effects on building competitive and open markets for food and other agricultural products.
  - Ensuring that the provision of food aid is consistent with long-term sustainable development objectives and, in particular, collaborating with other donors in focusing efforts to promote a transition from relief to development.
- Reduce food insecurity and malnutrition in areas especially vulnerable to famine emergencies through:
  - Enhancing the capacity of non-governmental organizations to plan and implement programs to improve food security, especially in countries where success of government-to-government assistance is problematical.
  - Targeting a portion of agricultural and food security programs to these areas.

AFRICAN DEVELOPMENT BANK

African Development Bank 2002 "African Development Report 2002: Rural Development for Poverty Reduction in Africa" Abijan, Cote d'Ivoire: The African Development Bank.
http://www.afdb.org/

Institutional Background: The African Development Bank provides loans and technical assistance grants. In 1998-2000, priority was given to agricultural and rural development and the social sectors which together accounted for 64, 62, and 42 percent of total loan and grant approvals.

OVERVIEW

Recent evidence shows that at a poverty line of US$1 person/day, Sub-Saharan Africa had the highest head-count ratio (close to 50 percent) among all world regions between 1987 and 1998. Poverty in many African countries is predominantly a rural phenomenon. The state of rural poverty is not only widespread, but it is also deep and severe, varying among countries. Overwhelming numbers of the rural poor are vulnerable to external shocks, natural disasters, conflicts and the spread of diseases, including HIV/AIDS. It is evident that, at the pace of current economic and social trends, the majority of African countries will not be able to achieve the Millennium Development Goals.

"Endogenous" constraints to African agriculture include:

- Low investment;
- Inappropriate policy environment for agricultural investment;
- Complicated land tenure systems;
- Limited participation of end-users in policy articulation and formulation;
- High level of post-harvest losses; and
- Inadequate adoption of available technology.

"Exogenous" factors inhibiting agricultural productivity include:

- High population growth which contributes to degradation of the environment;
- Poor state of basic infrastructure for delivery of social services;
- Absence of good physical infrastructure;
- Poor international prices for most primary agricultural commodity exports;
- Persistent instability, wars and civil unrest in some countries; and
- The presence of endemic diseases such as malaria and HIV/AIDS.

SPECIFIC RESEARCH RECOMMENDATIONS

Appropriate technology is recognized as being important.

- The new technology driven character of the global economy must be properly thought through: geography, ecology, and public health must be brought into the analysis of technological change and economic growth;
- Both advance and developing country governments need to change their approach to aid, by spending more and spending wisely;

- Participation in international assistance needs to be broadened and recast. Multinational firms and first-class universities and scientific establishments need to be engaged, and the official agencies charged with global development need to be enhanced;

- Institutional reforms for improving extension services must include decentralization, privatization, and separation of funding from execution;

- Location-specific technologies for African countries will require public intervention and local research and adaptation and also addressing intellectual property rights, agricultural research institutions, and competitive grants and negotiated contracts;

- There should be increased dissemination and use of improved agricultural inputs and practices. In the area of crops, the focus should shift to the use of high-yielding inputs that increase factor productivity. Technological change will involve more efficient use of chemical, biological, and organic inputs, introduction of high-value crops, use of improved farm implements and small-scale irrigation;

- In the livestock sector, husbandry techniques will have to be updated while transhumance production is gradually abandoned due to its low productivity and its adverse ecological impact. There is need to intensify efforts to diversify beyond cattle production into production of small ruminants and poultry, which offer opportunities for increasing rural income; and

- There must be a renewal of focus on rural-based processing of Africa's main cereals, legumes, and roots and tubers. The increased pursuit of upstream activities in the production of seeds, planting materials, farm implements, and tools as part of the strategy for rural poverty reduction will also provide the push for agro-industrialization to increase value-added in agriculture.

Better natural resource management requires a learning and partnership approach involving rural people, extension agents, researchers, and policy-makers. In the area of water access, apart from promoting increased investments in the exploitation of irrigation potential, rural farmers need to be organized for effective bargaining in obtaining access to critical agricultural water resources.

It is important to explore how globalization and markets impact the poor and what can be done to make markets (internal and external) and institutions work for the rural poor. With liberalization it is necessary to support market intermediaries and promote competition, transparency, and market access, if the transition to unregulated markets of poor farmers is to be facilitated.

Market reforms for rural poverty reduction cannot work effectively without micro-finance institutions that provide not only credit but a complete set of financial services including deposits as well as insurance. In designing rural micro-finance services, recent research has shown that is no single best type of micro-finance institutions and that different types of micro-finance institutions and strategies are required depending on the initial conditions of the rural location. Institutions must be tailored to the potential of the area, the cultural environment and the requirements of the clients.

Macroeconomic policies that have large effects on price incentives can be ineffective or even counterproductive if they are not accompanied by appropriate measures to improve supply response and increase market access for the rural poor. There are six instruments or *ins* that are required to stimulate the supply of output:

- Market liberalization and access that lead to higher producers' price;

- Inputs;

- Institutions (which may be strengthened by decentralization. The real challenge is how to design and implement institutional change that enables the poor and weak to use and benefit from those institutions, which were hitherto controlled by the rich and powerful);

- Infrastructure (rural transport, water supply and sanitation);
- Information; and
- Innovation or technology.

The focus on agricultural and rural development continues to be at the center of the growth aspects of the Bank's poverty reduction strategy. The main components of the strategy are:

- Enabling policy framework;
- Focus on priority sectors (e.g., agriculture, rural infrastructure, education, health and clean water supply);
- Recognition of the important role of women in development.

Other elements encompass crosscutting issues such as:

- Protection of the environment;
- Promotion of the private sector;
- Coordination of poverty reduction efforts with development partners;
- Provision of targeted programs for vulnerable groups; and
- Facilitation of the involvement of beneficiaries and NGOs in the development process.

CGIAR SUB-SAHARAN AFRICA CHALLENGE PROGRAM (SSA CP)

Forum for Agricultural Research in Africa 2004 Sub-Saharan Africa Challenge Programme: Building Sustainable Livelihoods through Integrated Agricultural Research for Development: Securing the future for Africa's Children
Volume I: Programme Proposal June, 2004 (final edition)
Volume II: Reference Materials from the Consultative Programme Development Process
Volume III Report of the Programme formulation Workshop. Accra, Ghana. March, 2003
www.fara-africa.org

Institutional Background: The SSA CP is the fourth Challenge Program to be funded by the CGIAR, and the first in the "regular" procedure following the three "pilot phase" CPs. It was formally approved by the CGIAR in December, 2004 for its initial stage, with a budget of US$5 million. It is the first of the CGIAR CPs to be funded through a non-CGIAR institution, FARA. Being in the first months of implementation, there is not yet a Web page for document access.

OVERVIEW

The CP envisages a new paradigm that fosters synergies among disciplines and institutions, along with renewed commitment to change at all levels from farmers to national and international policy makers. Such a paradigm has its roots in Integrated Agricultural Research for Development (IAR4D). This "new paradigm" has evolved from the CGIAR Task Force on integrated natural resources management. The research and development objectives of IAR4D are focused on the following:

- Develop technologies to sustainably intensify subsistence oriented farming systems;
- Develop smallholder production systems that are compatible with sound natural resource management;
- Improve the accessibility and efficiency of markets for smallholder and pastoral products; and
- Catalyze the formulation and adoption of policies that will encourage innovation to improve the livelihoods of smallholders and pastoralists.

The four principal pillars of the CP are:

- Promotion of organizational and institutional change to enable cross-disciplinary research and development and multi-institutional collaboration;
- Capacity building for project teams, farmers, and scientists in African institutions;
- Information and knowledge management (including documentation of new methodologies developed) to disseminate widely the findings of IAR4D work; and
- Ongoing monitoring and evaluation, and a systemic approach to impact assessment, to track program progress towards overall goals, signal the need for need for mid-course adjustments, and document the returns on investment in IAR4D.

The program operates through "pilot learning sites, beginning with three Module I sites in the pilot phase, eventually expanding to nine. A complex GIS system was designed to screen agro-ecological, economic and demographic parameters to arrive at eventual sites. The ultimate goal of the GIS base is to enable extrapolation over time and space for eventual impact. For the initial sites, the final decision-making process took place during a meeting of representatives of the three Sub-regional Organizations (SROs) held at FARA headquarters June 10-11, 2004. The principle outcome of that meeting was the selection of the three Module I PLSs:

- Kano-Katsina-Maradi (Niger and Nigeria), (to be managed by CORAF/WECARD)
- Lake Kivu (Democratic Republic of the Congo, Rwanda and Uganda) (managed by ASARECA), and
- A transect that runs from northeast Zimbabwe through central Mozambique into southern Malawi (managed by SADC/FANR).

The three sites cover a range of agroecological zones, widely disparate rainfall regimes, widely differing policy, market and institutional environments, and a range of critical NRM issues at each site. Spatial analysis using the GIS model indicated that each of the PLSs is representative of much larger areas of Sub-Saharan Africa and millions of people in terms of characteristics such as agroecology, human and livestock population density, and market access. The three sites were chosen also to represent areas in each of the mandate areas of the three partner SROs. Future sites will be selected through a competitive bidding process among African institutions.

For each of the four research focal points: Sustainable intensification of production; production systems that are compatible with natural resource management; accessibility of markets; and policies that encourage farmer innovation; hypotheses have been derived for effective entry points for change. The key interactions of system "drivers" are being identified. A competitive grants program is being put in place for stakeholder institutions to compete for research elements within each of these sites and focal areas.

The CP has several features that make it a bold adventure in research organization and management:

- It is the first "regionally-focused CP;
- It is managed through a non-CGIAR institution, with the full support of the CGIAR Centers working in Africa;
- It pulls together a wide range of key stakeholders in African research and development coordinated through African organizations;
- It is collegially-designed and prioritized with high stakeholder participation;
- It is based on a fully integrated approach to enhancing productivity and well-being of resource-poor farmers (the IR4D approach);
- It is focused on "entry points" to key limiting factors to productivity;
- It is based on a quantitatively-defined GIS model to describe key "drivers" of production ecosystem processes, including economic, social and political factors;
- It will have an eventual matrix of nine sites from which to extrapolate widely across the region;
- The identification and resolution of critical points of intervention and impact will largely determine its eventual success.

COMMISSION FOR AFRICA

Commission for Africa. 2005 "Our Common Interest" Report of the Commission for Africa. London, UK: Commission for Africa. (March)
http://www.commissionforafrica.org/english/report/introduction.html

Institutional Background: Tony Blair, the British Prime Minister, started The Commission for Africa in early 2004 to review and assess the development status of Africa and the role of the international development community in Africa's development.

The 17 members of the Commission are mostly drawn from African political, economic, and social institutions.

Consultation and Preparation Process: Five objectives guided the Commission's work:

1. To generate new ideas and action for a strong and prosperous Africa, using the 2005 British presidencies of the G8 and the European Union as a platform;
2. To support the best of existing work on Africa, in particular the New Partnership for African Development (NEPAD) and the African Union (AU), and help ensure this work achieves its goals;
3. To help deliver implementation of existing international commitments towards Africa;
4. To offer a fresh and positive perspective for Africa and its diverse culture in the 21st century, which challenges unfair perceptions and helps deliver changes; and,
5. To understand and help fulfill African aspirations for the future by listening to Africans.

To prepare the report, the Commission met together three times during 2004-5, working on different themes of the report. Various international experts provided background papers on a wide range of development-related topics. In addition, five major regional consultation events were held across Africa (in Senegal, Cameroon, Zambia, Kenya, and Egypt), three national consultations in Tanzania, Uganda, and Zambia, and additional meetings in several major European countries and the US London-based secretariat coordinated the work of the Commission and the consultations, as well as a Web-based forum and review of many written submissions.

OVERVIEW

Specific attention to agriculture, natural resource management, and research are not central elements of this document, which has as its goal a much broader view of African development concerns: causes of African poverty and instability, improving governance, enhancing peace and security, human capital, and trade. The report argues that the interrelated causes of Africa's conditions require a coherent and comprehensive solution, in partnership among African countries and between them and the developed world. Governmental reform, along with the need for capacity building and accountability are primary areas of change that influence all sectors and programs within them.

SPECIFIC RESEARCH RECOMMENDATIONS

The AG/NRM research issues are addressed to some degree in Chapter Seven, "Going for Growth and Poverty Reduction." The report reiterates that the commonality of successful economic growth examples is good governance. In addition, it provides several key recommendations that involve agriculture and natural resource management:

- Agriculture has a crucial role to plan in advancing African economic growth and poverty reduction, since it remains the livelihood of 70-80 percent of the population. Environmental sustainability is also an important consideration in poverty reduction, since the livelihoods of the poor are both affected by and

influence natural resource management. "African should do more to improve the economic environment for farmers and firms."

- Investments in irrigation are urged since "irrigated land is more productive than land which relies on rain-fed agriculture," doubling the acreage by 2015 and increasing funding for irrigation by 50 percent.
- Support should be given to African national and regional markets.
- Increasing trade of African products through opening of global markets and reductions in tariff barriers and subsidies of the developed world, as well as reducing dependency on primary commodities are critical.

The document supports the AU/NEPAD Comprehensive African Agricultural Development Framework with a focus on:

- Irrigation and post-harvest infrastructure
- Research, innovation, and extension, specifically, "[R]ejuvenation of agriculture should include timely institutional innovations appropriate to each locality involving smallholders and other stakeholders." Funding recommendations are US $1.6 annually to regional research institutions, over and above the US$ 340 million now supporting the CGIAR.
- Tenure security
- Development of local and regional markets as part of planned urbanization.

There was discussion of the need to diversify agricultural production away from primary commodities and toward higher-value crops just as flowers, horticultural crops, fish and fish products, as well as some regional trade in rice.

Additional recommendations related on economic growth and poverty reduction include:

- Investments are also urged in rural infrastructure to support ease in crop marketing.
- Agricultural research is needed that will "closely address the problems and needs of local farmers in each place…Africa must choose its own research priorities" with funding from the international community "channeled through African research organizations and universities."
- Security of tenure is fundamental to encouraging local investment.
- Better understanding of the processes of climate change and of climate-induced threats to agricultural productivity are important.
- People, particularly poor people, need to be participants in economic growth, and served by microfinance institutions (MFIs) and information and communication technologies (ICTs). Generally, additional support for small enterprises, including family farms, is key.

CORAF/WECARD

Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles (CORAF)/West and Central African Council for Agricultural Research and Development (WECARD) 2004 "CORAF/WECARD Biotechnology and Biosafety Project Proposal 2004" Dakar, Senegal: CORAF/WECARD. http://www.coraf.org/

Institutional Background: The West and Central African Council for Agricultural Research and Development or Conseil Ouest et Centre Africain pour la Recherche et le Développement (CORAF/WECARD) was established in 1987 with the following mission:

a) To improve the efficiency and effectiveness of agricultural research in West and Central Africa by contributing the consolidation of the capacities of the NARS, through co-operation between its members, development partners, regional and international organizations, private sector, nongovernmental organizations, users of research results;

b) To consolidate the position of the West and Central African sub-region within the context of the international agricultural research and development.

CORAF is mandated to implement the sub-regional agricultural research.

Consultation Process: The proposal grew from the recommendation of a June, 2004 Ouagadougou conference, "The use of science and technology for increasing agricultural productivity in Africa: perspectives in West Africa" which called for "A West African Centre for Biotechnology." It was developed through a series of CORAF stakeholder meetings and consultative processes.

OVERVIEW

This document outlines a proposed Biotechnology and Biosafety Program (BBP). This program aims to support the integration of biotechnology and biosafety in a regional approach to building capacity in agricultural research and development that will complement traditional and organic approaches. The foundation for this initiative was formed through previous studies to include:

- Individual country research institutes possess insufficient capacity to undertake research independently for launching major biotechnology products due to funding and manpower constraints;
- The sub-region needs to collectively take advantage of the outcome of biotechnology work being undertaken by the International Agricultural Research Centres (IARCs) in the sub-region in collaboration with selected National Agricultural Research Systems (NARS);
- Biosafety implementation requires a wide range of technical expertise, all of which may not be present in one country;
- The harmonization of biosafety regulations in the sub-region will facilitate the movement of biotechnology products.

The proposed program has three components:

- A new program, the CORAF-BBP, for the integration of biotechnology and biosafety in agricultural research and development in West and Central Africa (WCA) has been developed with the support of USAID; it has a management structure and has outlined plans for implementing the priority activities;
- Priority plant and animal commodities as well as priority constraints to their production have been identified, and a mechanism to direct competitive funds towards addressing these constraints has been conceptualized;

- Opportunities for regional cooperation in instituting biosafety policy and regulations as well as critical steps in moving towards a functioning subregional biosafety system have been identified.

The proposed program has a decentralized structure, with a competitive bidding process to be used to identify stakeholder institutions for implementing the research component, and a region-wide biosafety program implemented by the program management organization coordinated by CORAF.

The constraints to agricultural production in the WCA vary depending on the culture, the geographical location, and the level of development of the country. But there are constraints to agricultural productivity that are common to all countries of the WCA, and the sub-region needs the capacity to assess and utilize the tools of agricultural biotechnology in removing such constraints, which include:

- Low production potential of animal and plant genetic material;
- Susceptibility of these resources to biotic (insects, viruses, fungal diseases, etc.) and abiotic stresses (acidity, salinity, heavy metal toxicity and drought);
- Poor utilization of agricultural products in agro-industrial processing;
- Strong pressures exerted on the agricultural environment as a whole and on genetic resources and the soils in particular.

Many setbacks in the use of biotechnology have been suggested by critics. The most serious of these and which can slow down the adoption of biotechnology and its products are linked to the following:

- High cost of the technology aggravated by the poor investment of both the public and private sectors;
- Problems related to the environment such as gene escape, and to human health;
- Intellectual property rights especially relating to patents, farmers' rights and biopiracy;
- Lack of explicit domestic biotechnology policies exacerbated by uninformed legal entities;
- Low biotechnology capacity including material and human resources;
- Low biosafety capacity including the lack of regulatory frameworks (policies and strategies, capacity evaluation, regulations and implementation mechanisms).

A set of scoring criteria were also developed by stakeholders in a participatory manner, covering relevant agricultural development criteria such as economic growth, social welfare, environmental quality, capacity development and potential impact at the sub-regional level. Weightings for sub-criteria of each of these were arrived at by discussion. Finally, scoring of each crop or livestock constraint by sub-criteria was performed by a wide group of stakeholders and the resulting scores averaged and weighted to arrive at a ranking of constraints.

Table 3: Ranking of Priorities – Top Plant and Animal Constraints by Weighted Scoring

Crop Constraint	Ranking
Sorghum Striga resistance	322.5
Groundnut Aflatoxin control	314.6
Groundnut Resistance to rosette and clump viruses	314.4
Cowpea Resistance to Striga	311.5
Cowpea Resistance to post-harvest insects (weevils)	303.5
Cowpea Resistance to insect pests affecting production (bugs, pod borers)	302.9
All crops Maintenance and evaluation of genetic resources	300.0
Sorghum Insect resistance (bugs, borers, etc.)	298.6
Maize Grain protein quality	295.4
Forestry crops Seed production	292.5
Tomato Resistance to Tomato geminivirus	292.4
Tomato Modified ripening	290.2
Coconut Resistance to lethal yellowing	289.1
Banana/Plantain Nematode resistance	288.0
Rice RYMV resistance	287.0
Banana/Plantain Resistance to viruses (CMV, BTV, BSV)	286.1
Tomato Nematode resistance	284.5
Cotton Resistance to Bemiscia tabaci and Helicoverpa	280.4
Cacao Resistance to Phytophtora sp.	280.1
Groundnut Control of storage insects (weevils)	280.1
Groundnut Resisance to fungi (rust, Cercosporia)	279.9
Cassava Resistance to the ACMV	279.5
Rice Pyriculariose resistance	276.1
Animal Constraint	**Ranking**
Goats/Sheep PPR	430.8
Cattle Trypanosomiasis	391.9
Cattle/Goats CBPP/PPCB	382.7
Cattle/Goats/Sheep Maintenance/Evaluation of genetic resources	377.1
Pork African Swine Fever	374.7
Cattle Tsé-tsé	371.5
Cattle/Goats/Sheep Heartwater	350.5
Cattle Foot and Mouth Disease	342.2
Poultry Newcastle Disease	339.8
Cattle/Goats/Sheep Helminthiasis	333.0
Poultry Helminthiasis	332.0

More specific crop and animal constraints have been listed in greater detail in the document.

A set of themes for biotechnology research has been developed:

- Application of molecular markers
- Application of genetic engineering
- Application of molecular diagnostics for animal and plant diseases.
- Plant tissue/cell culture and micro-propagation techniques
- Vaccines for livestock production

- Animal reproductive technologies
- Biosafety component, the primary focus of which component will be to develop a uniform set of biosafety guidelines and procedures for the region.

It is noted that since CORAF does not have legal standing, all contract agreements for holders of intellectual property used or distributed by the program will be entered into by stakeholder partner institutions. A public education and dialogue component is described.

INTERACADEMY COUNCIL

InterAcademy Council Panel on Agricultural Productivity in Africa 2004 "Realizing the promise and potential of African agriculture." Amsterdam, The Netherlands: InterAcademy Council, Royal Netherlands Academy of Arts and Sciences.
http://www.interacademycouncil.net/report.asp?id=6793

Institutional Background: The InterAcademy Council (IAC) was established in 2000 in the Netherlands. It is an independent non-governmental organization (NGO) that draws on international scientific expertise to advise international organizations such as the United Nations on specific projects. It is managed by a secretariat and overseen by a 15-member advisory board representing 15 national science academies.

Consultation Process: This report was initiated in March 2002 by a UN request to prepare "a strategic plan for harnessing the best science and technology to increase the productivity of agriculture in Africa" (v). A panel of 18 international experts, representing all world regions, was appointed by the IAC Board. Four regional workshops, attended by 150 participants, were held in Africa to solicit the views of African scientists and other stakeholders. In addition, several background papers were prepared. The Panel then met to draft its recommendations and report. The report was reviewed by international agricultural experts in the IAC peer review process.

OVERVIEW

The report states that improving the application of science and technology to African agriculture will boost agricultural productivity and enhance the sustainability of African agro-ecosystems, while also improving the food security of Africa's increasing population. It strongly endorses participatory approach that engages farmers in the science and technological research and adoption efforts. The report argues that the heterogeneity of African conditions and the reliance on rain-fed systems, in contrast to Asia, requires a multi-pronged approach that offers a regionally-based iterative process of analysis, strategy development, and planning and conducting of innovative and participatory pilot projects that can address local-level variation. Developing and implementing larger scale programs are left to "on the ground" institutions (xii) that can pursue "rainbow evolutions" (as distinct from a Green Revolution) for the myriad of existing farming systems (xviii). This local variability also puts "a premium on participation and feedback from farmers" (xx).

The report organizes it recommendations along four themes and against near, intermediate, and longer-term time frames:

1. To improve agricultural productivity through a full range of S&T options, concentrating on four key African farming systems: maize-mixed system, cereal/root crop-mixed system, irrigated system, and tree crop-based system, of which maize, rice, sorghum, millet, legumes, cassava, yams, cocoa, coffee, cattle and goats are the most important crop and animal products. These four systems were identified as having the greatest productivity potential while also exhibiting high prevalence of malnutrition (Chapters 3 & 4).

2. To build impact-oriented research, knowledge, and development institutions with scientists and local producers. Arguing that top-down research-extension has failed in Africa, the report argued for both "farmer participatory knowledge systems that are more gender sensitive" (217) and better linkages between university and NARS (218) as well as greater coordination through ISNAR of best practices across the continent. Achieving this requires not only donor funds (which are to be deemphasized) but a larger investment in agricultural R&D by African governments, by 10 percent per year to 2015 (220).

3. To produce a new generation of agricultural scientists,

4. To enhance the role of markets and policies to raise the income of the poor and increase food security (Chapter 7), and

5. To engage S&T for the benefit of African agriculture in the near term.

SPECIFIC RESEARCH RECOMMENDATIONS

Chapter Four of the report provides a comprehensive review of many available S&T options for a wide range of crop and animal products, as well as NRM strategies that could contribute to improved productivity and sustainability. Key crops include rice, maize, sorghum and millet, and root crops; livestock, aquaculture, and fisheries systems; and indigenous or locally important crops. NRM strategies discussed include integrated water management, soil nutrient management, and agroforestry. Other S&T foci included biotechnology, ICT, mechanization, post-harvest options, and enhanced nutrition.

Each pilot program would seek to incorporate the following components, most of which have a research element, using a production-processing-marketing-consumption chain and a participatory approach:

1. Assessing indigenous technology options for improved productivity and food security (e.g., no-till, manure, and integrated water use).
2. Assessing marketing potential and constraints for existing and prospective commodities.
3. Assessing new technologies for enhancing productivity and food security (Chapter 4):
   - integrated nutrient and soil fertility enhancement.
   - IPM using farmer field schools.
   - Small-scale water harvesting and use of micro-irrigation.
   - Biotechnology applications such as GMOs, biofertilizers, and biopesticides.
   - Improving farm implements and use of mechanization to enhance labor productivity, e.g., "A priority task for scientists is to develop technologies that can…reduce the hours of work and increase income per hour of work for women" (94).
   - Improving post-harvest techniques.
   - Improving nutritional quality of foods through breeding, selection, germplasm improvement, and agronomic measures (95-96).
   - Improved ICT and mapping.
   - Other non-research components suggested for each pilot project include promoting off-farm employment, establishing farmer field schools, and supporting producer cooperatives.

These suggestions were explicitly made without prioritization (210) on the grounds that such determination must be made with African involvement in national and regional context.

IFPRI

International Food Policy Research Institute (IFPRI) 2004 A Way Forward: Assuring Food and Nutrition Security in Africa by 2020: Prioritizing Actions, Strengthening Actors, and Facilitating Partnerships. Proceedings of an All-Africa Conference, April 1-3, 2004, Kampala, Uganda. Washington: IFPRI. http://www.ifpri.org/pubs/books/vi24.htm#download (full proceedings); http://www.ifpri.org/2020africaconference/wayforward.pdf (summary)

Consultation Process: The conference was organized jointly be IFPRI and the Government of The Republic of Uganda. There were 14 international co-sponsors, with significant funding by DANIDA and SIDA. Research organizations accounted for one fourth of the approximately 450 participants, with NGO/civil society, regional networks, government organizations, and international research organizations represented. It has been considered one of the most important "expert" consultations of the past few years. The many presentations were interspersed with consensus findings (with participant votes) on both development and the technology needs to support it. Development constraints were covered by region, with Northern, Western, Southern and Eastern-central Africa.

A vote of the very highest priority areas by all attendees (Africa-wide) was:

Economic growth, markets and trade	35.8%
Agricultural productivity	22.1%
Governance (particularly local)	19.6%
Human capacity	15.7%
Nutrition and health	6.9%

OVERVIEW:

FOCUSING ON PEOPLE AND THEIR PROBLEMS

Actions toward food and nutrition security should be prioritized according to their potential for delivering fast and sustainable impact. It makes sense to address worst things first, such as famine and severe hunger related to significant calorie deficiencies. Addressing food and nutrition security directly and indirectly requires recognizing people's problems, situation, and context. Most food- and nutrition-insecure people are in rural areas, and many of their constraints related to agriculture. Poor African governments must be supported to make the most strategic investments in rural areas and rural communities.

STRATEGIZING AND LINKING GOALS TO MEANS

The people-focused agenda needs to link the goals to a set of means in an appropriate context. And that context must be addressed when formulating sound "road maps." The agenda must be shaped with input from poor people, who require greater voice and influence. Strategies must build on these basics. Adjusted to context and country, these are the five priority areas of action:

- Strengthen governance and public accountability and end conflicts. If these basics are not met, little can be done for sustainable food and nutrition security.
  - The responsibility and accountability of the key food and nutrition security policy actors need to be clearly communicated and understood. Holding governments accountable, facilitating vigorous competition, assuring transparency in and building the capacity of civil society organizations, exposing the research community to national or international peer review for quality testing, and monitoring the quality of actions taken are key ingredients in enhancing the responsibility and accountability of strengthened actors.

  - Governance in the food and agricultural sector needs to be addressed at the macro as well as sectoral levels. This requires national governments to adopt and implement policies that encourage transparency and efficiency of food- and agriculture-related public organizations as well as of public and private operators serving agricultural and food and nutrition security.

- Foster macroeconomic growth and stability facilitated by:
  - Free access to domestic, inter-regional, and international markets and trade;
  - A more cohesive and louder African voice in the World Trade Organization (WTO);
  - Better investments in the assets of the poor;
  - More effective management of vulnerability to shocks, including through household, national and regional food storage; and
  - Greater investments in infrastructure to lower transportation and communication costs and encourage rural-urban and intra-regional linkages.
- Invest in raising agricultural productivity, especially among small farms, thereby addressing the food availability and income poverty aspects of food and nutrition security within the larger context of policies for agricultural and rural development. The sustainability of agricultural productivity requires strong attention to environment and natural resources, especially soils, watersheds, and biodiversity. Invest in processing for more value addition and quality assurance in the supply chain of agricultural products.
- Invest in pro-poor public health policies and actions, in particular the prevention, control, and management of HIV/AIDS, malaria, and tuberculosis, to foster food and nutrition security and raise labor productivity.
- Invest in building human capacity by addressing the education needs of women, girls, and boys; upgrading the professional skills of farmers and other rural producers; and meeting the need for higher education to produce better educated and more-informed actors and stakeholders who can implement actions for nutritional improvement.

ALIGNING THE SCALE OF INVESTMENTS IN FOOD AND NUTRITION SECURITY WITH THE EXPECTED RETURNS

The search for marginal improvements in food and nutrition security at the lowest cost must be replaced by a focus on the political change and investment needs of getting the job done.

IMPLEMENTATION TEST OF STRATEGIES

No food and nutrition security strategy, whether at a continental, sub-regional, national, or local level, is viable if it does not include a well-developed and well-articulated implementation framework.

SETTING PRIORITIES FOR IMPLEMENTATION AND SEQUENCING

- Scale up agricultural growth in the smallholder sector to help reduce poverty and food insecurity.
- Scale up investment in local, national, and regional infrastructure, including roads and provision of safe water and proper sanitation.
- Design policy change to bring down domestic and inter-regional barriers to trade for food and agricultural products within Africa, and to open up OECD markets for African products, especially high-value products.

- Scale up nutrition- and food security-related investments in combined health and education programs, reaching the food and nutrition insecure through schools, health centers, hospitals, and communities, and support social safety nets.

Each of these must be implemented by different groups of actors, which can change from country to country. The best means of implementation can be determined only in a country context. But best practices can and must be shared across Africa.

INVESTING IN AGRICULTURE

The agricultural investment needed, both public and private, is highly diverse based on agro-ecology. There are, however, at least three common top priorities:

- Investing in improved seeds and livestock that fit the agro-ecology.
- Investing in the development and utilization of water for productive purposes and rural health.
- Investing in a continent-wide effort to achieve sustained soil fertility.

INFORMATION/COMMUNICATION CONSTRAINTS

With severe limitations on both physical and institutional infrastructure, considerable emphasis is placed on information technologies, operating through networks at various levels (for information on science, on technologies, and on markets for both input availability and price and for product sales.) Research "density" over geographical and human population space is, and will continue to be low, regardless of feasible near-term investment. At present, for instance, in North Africa fewer than 20 percent of producers are linked to producer/"professional" organizations. Research networking, farmer organizations, and networks of community-based organizations are of high priority.

SPECIFIC RESEARCH RECOMMENDATIONS

The following were listed as specific research-supported needs:

MARKET NEEDS/TRANSACTION COSTS

Physical transportation infrastructure is obviously limiting, but market organization and marketing information is a major need. This was stressed time and again, and appears throughout the proceedings, as it does in most African priority-setting activity. There are many calls for market research, to determine the most effective forms and participant structures for the many African environments and variability in political and stability and in security.

WATER MANAGEMENT

Adaptability for local, community-based, and on-farm techniques to partially compensate for high uncertainty and the growing water scarcity is a common theme.

SOIL FERTILITY/FERTILIZER AVAILABILITY AND PRICE/NATURAL RESOURCE MANAGEMENT

These components are intimately linked. It is increasingly agreed that much can be done with local resources, but by themselves they are far from sufficient. Likewise, sole reliance on fertilizer is inefficient, particularly at existing prices. Fertilizer commonly sells at farm level, from $400 to $700 or more per ton for nitrogen and phosphorus, the two most limiting nutrients. Markups from world price are huge, with minimal distances and few transactions. It has been shown that much of this is due to non-open market structure and monopolies in the trade. Farmer organizations are beginning to make inroads into the trade. Likewise, biologically integrated ways of inserting fertilizer into a soil management programs are crucial. Organic matter/crop and animal residue management is gaining slowly, but needs further research.

VARIETAL DEVELOPMENT
The Nerica rices are beginning to make significant impact, but considerable work is needed on drought tolerance, pest resistance, and nutritional quality. The breeding of dual purpose varieties for feed quality was mentioned.

PEST MANAGEMENT
Insect, disease, and parasite resistance is greatly needed. Striga resistance and management is a critical need in several cereals. Integrated and biological control is required.

ANIMAL PRODUCTION SYSTEMS
The animal industry in Africa is undergoing major transformation with reduced transhumanance, reduced grazing, and much higher animal numbers in more confined operations. Production is way behind the growing market demand, and projections to 2020 show greatly increased dependence on imports.

FORESTRY/AGRO FORESTRY
Required especially for trees integrated into the landscape. The opportunity for high value forest products, some just now coming into domestication, is stressed.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

Johnson, Michael and Danielle Resnick with Simon Bolwig, Jordan Chamberlin, Liangzhi You, Stanley Wood, and Peter Hazell 2004 "Strategic Analysis and Knowledge Support Systems (SAKSS) for Rural Development Strategies in Sub-Saharan Africa." Development Strategy and Governance Division (DSGD) Discussion Paper No 14, (October 2004) International Food Policy Research Institute, Washington, D.C.
http://www.ifpri.org/divs/dsgd/dp/papers/dsgdp14.pdf

Institutional Background: IFPRI is one of the CGIAR centers. The SAKSS is a methodology, or organized system of methodologies, by which data, tools, and knowledge are compiled, analyzed, and disseminated for the purposes of identifying a set of priority investment and policy options to promote agricultural and rural development in a country. A distinguishing feature of SAKSS is its emphasis on spatially relevant information.

OVERVIEW

The ultimate objective of the analysis is to identify a set of targeted policy and investment options – and thus, development alternatives – to yield rapid and sustained increases in productivity and commercialization of smallholder agriculture. It has five sequential steps:

1. Set the context of the rural development strategy within the broader economy-wide goals of achieving growth and poverty reduction. Economy-wide models like the Computable General Equilibrium (CGE) and multi-market models are well suited for answering many of the questions.

2. Characterize the magnitude of the problem facing rural areas (such as those areas requiring immediate access to food) and explore spatially explicit 'development domains." Useful tools in the spatial analysis of development domains are the Geographic Information Systems (GIS) and remote sensing.

3. Assess key investment and policy reform options, both those specific within a spatial domain and those more broadly relevant across domains, in terms of their contributions to income growth, poverty reduction and environmental stability: Prioritizing sub-sector and commodity-oriented investment options; identifying key priority commodities; identifying investment and policy reform options for each priority commodity; prioritizing thematic lines of investment options.

Once choices have been identified and verified through logically defined decision-making processes and stakeholder dialogue, further analysis to:

4. Review best practices and lessons learned for designing and implementing the chosen set of investments and/or policy reforms,

5. Develop a monitoring and evaluation system in order to assess whether the chosen investments are on track to achieving target outcomes, e.g., income growth, poverty reduction, and reduced malnutrition. Indicators must be SMART: specific, measurable, accessible, relevant, and time-based.

Applied to specific situations:

- With regard to assessing the growth required to meet the MDGs, only Ghana seems closest to meeting this goal at current growth rates. Zambia can hardly expect to do so, at least until 2045. Almost all the case studies emphasize how infrastructure improvement and market development will have to accompany investments in agriculture if the sector is going to play any significant role in reducing poverty. In comparing across countries, both Ghana and Zambia seem more likely to face a collapse in domestic food prices due to limited domestic demand. Although Ethiopia faces a similar outcome, domestic demand is almost always constrained by high transportation and transactions costs.

- Development domains were identified for Uganda on the basis of high and low population density and market access across seven zones of different agricultural potential. The analysis distinguished between local markets where low-value food crops are bought and sold; regional markets were low as well as higher valued commodities, including perishables, are sold; regional markets of non-perishable food crops via the border with Rwanda and DRC; access to the Kigali-Kampala-Nairobi-Mombasa rail corridor for non-perishable exports; and "international fresh markets" for horticulture via the airport at Entebbe.

- In Uganda, recent findings by Fan, et al. (2004) show clearly that the returns to government investments are particularly high for agricultural research and development (R&D0, rural feeder roads, and education. The prevalence of high undernourishment, HIV/AIDS and malaria, and illiteracy, can prevent many households and communities from taking advantage of policy incentives and public investments designed to stimulate growth and development. Results of CGE analysis show larger growth effects of an export-oriented strategy, focused on improvements in total factor productivity of export crops (coffee, maize, horticulture, and other crops). In contrast a similar shock in non-tradable staple commodities (plantain, cassava, sweet potato, millet, and sorghum) results in depressed producer prices.

- For example, on the sequencing of public investments, a review of lessons from India suggests that large rural infrastructure investments (roads, irrigation, and agricultural research and extension) are fundamental prerequisites. Without basic road infrastructure to link farmers to markets, most African farmers will continue to depend on low input technology. Unfortunately, the abrupt withdrawal of public sector involvement in provision of inputs like fertilizer and seeds, and the procurement of smallholder output, simply forced a majority of African smallholder producers to return to subsistence farming. Meanwhile, governments throughout Africa neglected to establish well-functioning market institutions and a regulatory environment to encourage the private sector to enter in its place. As a result, high costs and difficulties in distributing improved technologies due to poor infrastructure and market development have kept out the private sector from assuming this role. As long as delivery costs remain exorbitantly high due to poor infrastructure and production uncertainties, there may be justification for an initial fertilizer subsidy, at least until such constraints have been removed. Among the case studies reviewed, the most successful interventions were found to be those related to: soil and water conservation, replication of proven commodity-specific breeding and processing successes (e.g., cassava), marketing and information systems, vertical supply chains to improve efficiency, and improving regional cooperation in trade and agricultural technology. Overall, the evidence from the successes reviewed suggested two fundamental prerequisites for sustained agricultural growth in Africa: good governance and sustained funding for agricultural research and extension.

Case studies in countries such as Sudan, Ethiopia, and Chad have shown that early warning systems have not been uniformly successful in mitigating famines and saving lives.

Other lessons learned include:

- Increased data and information does not automatically translate into action by decision-makers.

- In order to achieve sustainability, countries ultimately need to have ownership of SAFSS, which supports the objective of institutionalizing SAKSS within local government and research institutions over time.

- There is large value of starting with a manageable research focus.

Finally, and most importantly, since the broader process of designing and implementing strategies is inherently political, successful long-term strategies will naturally depend on strong leadership commitment, including sufficient autonomy to guide and sustain national strategies.

NEPAD

New Partnership for Africa's Development and the African Union 2003 "Comprehensive Africa Agriculture Development Programme (CAADP)" (July) Midrand, South Africa: NEPAD. http://www.nepad.org

CAADP

CAADP 2004 "CAADP Implementation Concept Note: Multi-Country African Agricultural Productivity Program (MAPP)" Technical Background Document Prepared for the Regional Implementation Planning Meetings, January to April 2005. http://www.nepad.org

CAADP 2005 "Implementing the Comprehensive Africa Agriculture Development Programme and Restoring Food Security in Africa: 'The Roadmap'."

Institutional Background: The New Partnership for Africa's Development (NEPAD) is a strategic framework for African development initiated by the former Organization of African Unity (OAU), now African Union (AU). In 2002, it began a consultative process to shape a program concept for developing African agriculture. That effort, supported by the Food and Agriculture Organisation of the United Nations (FAO) resulted in this document, the "Comprehensive Africa Agriculture Development Programme" (CAADP).

Consultation Process: An initial draft statement was developed in March 2002 and circulated to a wide range of stakeholders, including all African Ministers of Agriculture, NEPAD officers, African regional and subregional Bank executives, and key agricultural staff in the donor community, among others. Four regional implementation planning meetings are being held from November 2004 to March 2005. It is through the consultation process that the pillar themes identified below are expected to be molded into specific implementation plans for each nation and region (20).

OVERVIEW

African agriculture is said to be in a crisis situation. The continent's population is growing at 2.8 percent per year. To hold the line on absolute numbers of people in poverty, an annual economic growth rate of five percent is needed – twice that achieved since 1973. Even higher growth rates are pledged by NEPAD leaders—six percent per year in the agriculture sector—with concurrent pledges to support and improve the performance of agriculture as a key engine for Africa's growth.

To create this dynamic agriculture sector, the CAADP argues for investing[45] in shorter-term mutually reinforcing pillars:

1) Extending the area under sustainable land management and reliable water control systems;

2) Improving rural infrastructure and trade-related capacities for improved market access;

3) Increasing food supply and reducing hunger; and

4) An additional, longer-term fourth pillar explicitly addresses the needs for agricultural research, technological dissemination, and adoption.

The MAPP concept note more narrowly addresses technology dissemination and the creation of national agricultural technology systems that "are responsive to opportunities and constraints facing farmers" (3), based on principles of farmers' participation in setting research priorities, promotion of competitive systems of service delivery, greater accountability of technology generation and transfer institutions, and cost sharing with end users (4). The proposed program, which will be implemented through FARA, is primarily

[45] Pillar one, US$31 billion; Pillar two, US$ 92 billion; Pillar three, US$ 42 billion, and Pillar four, double the current levels of investment, from US$2.3 billion annually to US$4.6 billion. Total desired investment levels are $251 billion (3).

supportive of institutional strengthening, but does mention interventions to **strengthen research services** for technology generation (4).

NEPAD's vision for African agriculture seeks "to maximize the contribution of Africa's largest economic sector" to advance as a full player "on the world stage" (8). Its agricultural goals include: attaining food security, improving agricultural productivity, focusing on small-scale farmers, especially women, developing dynamic regional and international agricultural markets, achieving greater equity, becoming a strategic player in agricultural S&T, and practicing sound environmental production methods (9).

SPECIFIC RECOMMENDATIONS FOR RESEARCH

Most of the document does not define specific research priorities or projects. It discusses the three pillars above and recommend new investments in each, all of which are needed to ensure a growing agricultural sector, and all of which clearly have research priorities embedded within them, some of which are mentioned: forecasting for drought, improved water management, combating desertification, and disease prevention for livestock. The FAO SPFS program assists developing countries to improve household and national food security through "empowering small farmers to achieve rapid increases in productivity and reductions in year-to-year variations in output" (52). Four intervention areas are identified:

- Water and soil management;
- Raising productivity, including improved plant varieties, integrated plan nutrients, pest management systems, and post-harvest technologies;
- Farm diversification to improve household nutrition and income and reduce vulnerability through small livestock keeping including artisanal fisheries and aquaculture; and
- Participatory study of socio-economic constraints.

In most cases, more specific topics are left to the participatory process of the creation of national and regional implementation plans.

In the chapter devoted to research and technology development and dissemination,[46] however, five themes (listed below) and related (uncosted) projects are identified, with the understanding that the "search for change" for new technologies must be continued, but also "supported by effective means to ensure adoption" (60). The report states that agricultural research on "pearl millet, maize, sorghum, potatoes, beans, wheat, and cowpeas has generated returns of 16 percent to 135 percent" (60).

1. Integrated NRM, to halt resource degradation and to improve soil fertility (71) and water management (73).
2. Adaptive management of appropriate germplasm, to develop high-yielding varieties of crops and livestock that are disease and pest resistant and adapted to biophysical constraints of Africa, such as low soil fertility and disappearing labor (74).
3. Development of sustainable market chains, with research to test hypotheses about the role of input and output markets on poverty traps and on the relative benefit of cash crops v. staple crops in improving farm income.
4. Policies for sustainable agriculture, addressing polices to ensure food security and promote agricultural production that is environmentally sustainable. Other topics include investigation of emerging markets in ecosystem services (biodiversity, carbon sequestration, watershed protection) and their benefit for smallholder.

[46] This chapter states that it builds on lessons learned from the ASARECA, CGIAR, CORAF/WECARD, FAO, FARA, Special Programme for African Agricultural Research (SPAAR), and the Southern Africa Centre for Co-operation in Agricultural Research and Training (SACCAR) – see summary of SPAAR/FARA, page 85.

5. Scientific capacity building, including revitalization of degree-training programs and the integration of social and biological science approaches.

The chapter on research takes special notice of the role of African women in African agriculture and NRM, and suggests expanded support to providing more information to women about agricultural markets, and to build up marketing institutions involving women (78).

The "Roadmap" for the CAADP implementation program identifies the following additional research components:

- Multi-Country African Agricultural Productivity Program (MAPP);
- A Pan-Africa **Cassava** Initiative;
- A Pan Africa NERICA (**rice**) Initiative; and
- A fish sector development component.

ASARECA/IFPRI

Omamo, Stephen W., Xinshen Diao, Stanley Wood, Jordan Chamberlin, Liang You, Sam Benin, and Peter Hazell "Agricultural Development Policy in Eastern and Central Africa: Strategic Priorities for Growth and Poverty Reduction" A report prepared under the ASARECA/IFPRI Project Strategies and Priorities for Sub-Regional Agricultural Development and Sub-Regional Agricultural Research-for-Development in Eastern and Central Africa.

Institutional Background: IFPRI is one of the CGIAR centers. The primary authors of this report included Steven Were Omamo, Xinshen Diao, Stanley Wood, Jordan Chamberlin, Liang You, Sam Benin, and Peter Hazell. A Steering Committee of Seyfu Ketema, Adiel Mbabu, Isaac Minde, Abdelmoneim Taha, Howard Elliott, Geoffrey Ebong. Steven Were Omamo oversees the work program.

Consultation Process: The report's analytical approach, results, and recommendations were presented to a range of stakeholder groups, including those attending several meetings of the ASARECA Committee of Directors, and those at the planning meeting to launch the implementation of the Comprehensive African Agricultural Development Programme (CAADP), January 25-28, 2005, Dar es Salaam, Tanzania.

OVERVIEW

The report is rich in well-presented demographic and economic data which was used as a source. The report presents a model-based "strategic analysis for the EAC region" which presents alternative agricultural development strategies and their impact on poverty. Individual commodities are projected, with estimates for potential of each in both high and low potential areas, and with high and low market access, all projected within conditions of high and low population density. Research implications and priorities were not explicitly addressed, but they were strongly implied.

ANALYTICAL APPROACH

The analytical approach is explicitly strategic:

- First, using geographic information systems (GIS) methods to identify and depict spatial similarities and differences in the context facing agriculture in ECA, the analysis spans all 10 countries in the region thereby permitting simultaneous focus on both national and regional phenomena.
- Second, using a dynamic economic model of agriculture in ECA known as a multi-market model, the analysis takes in numerous agricultural and non-agricultural sub-sectors while simultaneously tracking broader economic conditions in a forward-looking setting.
- Third, the analysis uses a model that quantifies impacts of productivity-enhancing investments in agricultural R&D known as the Dynamic Research Evaluation for Management (DREAM) model.

SUMMARY OF THE ANALYSIS

The business-as-usual outcome sheds important light on the largely disappointing results in ECA of agricultural development policies in the 1980s and 1990s that concentrated primarily on reducing impediments to trade in agricultural markets. Specifically, in the absence of agricultural productivity growth, both trade liberalization and reductions in domestic marketing costs are shown to result in GDP and AgGDP growth rates little different from those in the business-as-usual scenario. ECA governments and donor agencies that surmised that "letting agricultural markets work" meant assigning peripheral roles to public sectors in agricultural development could not have been more wrong. Further analysis yields numerous insights into the nature of agricultural development that might allow countries to avoid business-as-usual outcomes:

- Achieving GDP growth rates required to meet MDG poverty reduction targets would imply threefold increases in agricultural sectoral and sub-sectoral growth rates.

- Whereas growth in export sub-sectors is often put forward as a pathway out of poverty for countries in ECA, the analysis reveals that the largest poverty reduction impacts would come from growth in sub-sectors for which demand is greatest *within the region*—e.g., staples, livestock products, oilseeds, and fruits and vegetables. Increasing productivity in these sub-sectors would directly benefit the great majority of ECA's numerous small farmers by easing key resource constraints in the activities to which they devote most of their resources.

- Balanced growth strategies featuring growth in a number of agricultural sub-sectors lead to higher overall economic growth than does that featuring growth in a small number of sectors.

- Agricultural productivity growth alone is insufficient to meet MDG poverty reduction targets. Growth in non-agricultural sectors and improvements in market conditions is required.

- Because poverty rates vary geographically within countries, growth strategies that take such differences into account lead to larger reductions in poverty than do those that ignore such differences.

- The agricultural development domain characterized by high agricultural potential, low market access, and low population density (HLL) emerges as the clear priority for efficient, equitable, and sustainable growth in the region. Greatest scope for broad-based benefits from regionally conceived initiatives in agricultural development resides primarily in this domain. That scope would appear to be substantial. Agriculture-based growth in the LLL, HHH, and HLH domains is also important and likely offers scope for both poverty reduction and benefits from regional cooperation. But such potential is likely to be more difficult to achieve. Agriculture-based growth in the LHH, HHL, LLH, and LHL domains is unlikely to be large enough to warrant major investments in agricultural development. Best-bet growth enhancing options in these areas are likely to lie outside agriculture.

- Using agricultural R&D as an illustration, significant returns to regional cooperation in agricultural development are identified.

SPAAR/FARA

SPAAR/FARA 2000 "Vision of African Agricultural Research and Development" Special Program for African Agriculture Research, SPAAR/FARA Plenary Session, Conakry, Guinea (April 9-14, 2000).
http://www.aec.msu.edu/agecon/fs2/africanhunger/visionafrica.pdf

OVERVIEW

According to the Vision statement, by the year 2020, the continent could:

- Have dynamic agricultural markets among nations and between regions;
- Be a net exporter of agricultural products;
- Have food availability and affordability, equitable distribution of wealth;
- Be a strategic player in science and technology development, especially in agro-medical fields; and
- Have a culture of sustainable use of the natural resource base.

These changes are predicated on an annual economic growth rate of 4 percent, from the current 2 percent. Reaching an average 4 percent annual economic growth rate in most African countries requires an even larger annual growth rate for agriculture, about 6 percent, because of the relatively large contribution of agriculture to GDP (about 35 percent) and the fact that in most countries the major private businesses are agro-industry, agricultural marketing and farm input supply.

The basis for hope:

- Much greater investment in agricultural research extension, infrastructure, transport, general education, and health will be needed to enable all Africans to have access to food.
- On the technological front, there are many improved varieties and food production technologies already available or well-advanced in the pipeline that have the biological potential to double and triple traditional yields.
- Earlier-maturing, high-yielding varieties of maize, rice, sorghum, cassava, and grain legumes offer exciting new possibilities for multiple cropping, including green manure crops.
- Conservation tillage offers greater hope to check soil erosion, conserve moisture, and reduce the back-breaking work and drudgery of weeding and land preparation.
- Nutritionally-superior maize varieties are being enthusiastically adopted in a growing number of countries.

Africa has yet to capitalize on its rich indigenous knowledge and develop mechanisms that will enable its institutions to acquire and utilize appropriate technologies.

A concerted effort is needed to address the distortions in agricultural markets, enhance the production-consumption continuum, improve access to basic infrastructure, and protect the natural resource base. The full potential of African agriculture must be captured by:

- Completing the large unfinished policy agenda, including anti-export biases in trade regimes, remnants of marketing boards and parastatals in some countries.
- Breaking through demand barriers: enhance private agribusiness environment and skills, foster (sub) regional economic and trade integration; access to OECD agricultural and food markets.

- Sharply improving access to public infrastructure and services.
- Promoting agriculture-led industrialization through value-added activities. Domestic improvements in business practices remain critical in an era of global competition, as does improved access to sub-regional and OECD markets for processed goods.
- Improving input markets and use: promote sub-regional seed, fertilizer markets; improve access to fertilizer by eliminating remaining policy distortions and monopolies.
- Bringing the best and most appropriate science to bear through the development, adaptation, and dissemination of new technologies.

The capacity-building implications of the Vision are far-reaching, including not only traditional approaches – e.g., training, provision of equipment, and organizational restructuring, but also more broadly, issues related to content and process, and the administrative frameworks that establish, implement, and enforce rules and incentives to spur efficient decision-making, operational performance and information management and sharing – including both the incorporation of indigenous knowledge and the availability of the requisite hardware and software for carrying out tasks. Of significant importance are issues related to the institutional arrangements, including the rules and incentives, how to educate, attract, retain, motivate, and train professionals, and how to improve governance so that decision-makers act opening and responsibly.

SPECIFIC RESEARCH RECOMMENDATIONS

A new agricultural research system is needed that:

- Is demand-driven, responsive to clients' needs, and more closely linked to development objectives for greater impact. The challenge is to move away from the liner mode of operation (research, extension, and farmer) to a technology development and transfer system, squarely centered on farmers' realities and needs. Impact-oriented research rests on strong and effective public institutions and on farmers' access to new technologies and on their capacity to selectively adopt and adapt them to their needs and circumstances. The new research paradigm puts a premium on smallholder farming and small-scale agribusiness and seeks a major impact on women, youth, and the disadvantaged. While in the past, increases in cultivated area provided much of the required incremental production to meet the needs of rapidly increasing populations, the future agricultural growth will depend heavily on enhanced productivity of both land and labor.
- Addresses the whole value chain, from production, processing, marketing, to value-adding concerns linking it to nutrition, health, income, and overall food security.
- Consolidates and expands traditional markets while exploring and exploiting emerging market niches (e.g., mio-medicals).
- Is more actively involved in policy formulation, implementation, and monitoring and evaluation.

CENTRAL ASIA AND THE CAUCAUSES, WEST ASIA, AND NORTH AFRICA

Note: This clustering was done based on the "CWANA" coverage of the AARINENA, World Bank/Cairo and ICARDA priorities processes, where CAC is treated as a "sub-region" of CWANA

AARINENA

Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA) 2000 "AARINENA in 2000 and Beyond: A Framework for Action (2000-2005)," Amended and adopted at the 7th General conference, Beirut, Lebanon (March 2000). Tehran, Iran [?]: AARINENA.
http://www.aarinena.org/rais/documents/General/Frameworkforaction.pdf

Institutional Background: AARINENA was established in 1985 to strengthen cooperation among national, regional, and international research institutions and centers through the dissemination and exchange of information, experiences, and research results. It includes five sub-regions:

- Arabian Peninsula (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE)
- Maghreb (Algeria, Malta, Mauritania, Morocco, Tunisia)
- Mashreq (Cyprus, Iraq, Jordan, Lebanon, Palestine Authority, Syria)
- Nile Valley & Red Sea (Djibouti, Egypt, Sudan, Somalia, Yemen)
- Western Asia (Iran, Pakistan, Turkey)

OVERALL FINDINGS

The list of areas of interest/priorities for AARINENA support and formation of linkages has grown to include five major themes, each of which is detailed below:

- Genetic Resource Management (GRM),
- Natural Resource Management and Ecology (NRM),
- Commodity Chain, Policy Management and Institutional Development, and
- Information Management for Agricultural Research Development.

SPECIFIC RECOMMENDATIONS FOR RESEARCH

- Genetic Resources Management (GRM)
  - Genetic Engineering for Stress Tolerance in Agronomic Plants in the Arabian Peninsula Sub-Region.
  - Development of Biotechnological Research in the Maghreb States
    - Establishment of biotechnology laboratories in Maghreb countries
    - Selection of appropriate techniques for national programs
    - Trained specialized personnel in national programs
    - Established research teams in national programs
    - Exchange of information on new developments

- Development of Wheat Cultivars for Durable Resistance to Leaf and Stem Rusts in the Nile Valley and Red Sea Region
- Development of Wheat Cultivars with Durable Resistance to Yellow Rust and the Identification of Wheat Yellow Rust Pathways in the Near East and North Africa.
- Dairy Sheep Breeding for Small Flocks Based on Simple Recording
- Central and West Asia Yellow Rusts Regional Network

- Natural Resources Management and Ecology (NRM)
  - Use of GIS and Modeling Techniques for Hydrologic Research and Management of Water Resources
    - An increased number of qualified specialists and technicians in the field of water resources management and related areas such as data acquisition, processing, modeling, and water planning computations.
    - Increased information exchange between countries and sharing of appropriate knowledge and technology in the field of water resources management studies.
    - Improved exchange of information and experience between water resource institutions in the Region.
  - Water Management and Increasing Water Use Efficiency for Sustainable Agricultural System.
  - Integrated Feed/Livestock Production Systems using Non-Conventional Feed Resources in the Al-Mashreq Region
  - Integrated Pest Management in Cereal and Food Legume Based Cropping Systems in the Maghreb Countries.
- Commodity Chain
  - Regional Network for Date-Palm in the Near East and North Africa
- Policy Management and Institutional Development
  - Regionalizing Agricultural Research within Countries in the Maghreb Region
  - Strengthening National Seed Policy and Production Systems
- Information Management for Agricultural Research Development
  - Development of an Agricultural Information System for West Asia and North Africa
  - 15 VERCON - Using the Internet to Improve Research-Extension Linkages

ICARDA

Belaid, A., M. Solh, and A. Mazid 2003 "Setting agricultural research priorities for the Central and West Asia and North Africa Region: Toward a new NARS/NARS and CGIAR/NARS collaboration spirit." ICARDA (March)
http://www.icarda.org/ARP_CWANA/ARPS_FINAL_REPORT1.htm

Institutional background: ICARDA, the CGIAR Center for Agricultural Research in the Dry Areas, was founded in 1971, and coordinates many of the CGIAR programs in Central and West Asia and North Africa, the CWANA region. It works collaboratively with the Central Asia and the Caucasus NARS Forum (CAC forum), headquartered in Tashkent, and with the Association of Agricultural Research Institutions of the near East and North Africa (AARINENA).

Consultation Process: This study was instituted as a CGIAR-sponsored effort to focus on regional priority setting. The document is the outcome of more than two years of truly bottom-up, participatory priority setting throughout CWANA, involving NARS, NGOs, farmer organizations, private sector and regional organizations, along with scientists from CGIAR centers active in the region.

The collaboration centered around three pillar activities:

1. A series of sub regional brainstorming meetings
2. A questionnaire widely distributed across the region to various stakeholders
3. A final regional meeting that brought together (national, regional and international) stakeholders with different backgrounds and levels of responsibility within national agricultural research systems.

OVERVIEW

From the sub-regional brainstorming meetings held in Central Asia and the Caucasus (CAC), the Nile Valley and Red Sea, West Asia, North Africa, and the Arabian Peninsula, the emergent overall priorities were:

- An emphasis on environmental issues, with sustained research and policy efforts to preserve water, soil, and genetic resources
- Water was the central issue in the region, to be addressed at the three levels of the watershed, community, and farm, including water use efficiency at the farm level, sustainable management of ground and surface water, safe use of waste and brackish water, salinity control, and institutional and policy aspects of water use and management.
- The need for better regional collaboration to reduce overlap and foster joint research

Five criteria were evolved from the collaboration and were suggested for priority weighting:

- Productivity (competitiveness): the likely impact of the research priority identified on yield, cost/risk reduction, and product quality
- Poverty alleviation: the extent to which resource-poor smallholders, landless laborers in rural areas, especially marginalized ones, would benefit from the identified research priority
- Resource conservation: (sustainability): the contribution of the research priority to the protection of the resource base
- Household food security: the likelihood of the research priority to increase the stability of staple food availability

- Contribution to development: the extent to which the considered research priority would contribute to overall development

SPECIFIC RESEARCH RECOMMENDATIONS

The results of the sub regional survey showed differences in the weightings, but productivity had the highest weighting except for Ethiopia, which rated food security highest. Food security was second overall, with resource conservation slightly ahead of poverty alleviation.

For the CWANA region as a whole, the priority groupings were:

- Germplasm management (five areas)
- Improvement and biotechnology was the top, followed by conservation within this category
- Crops (13 listed): Wheat, forages, barley and vegetables were at the top, but differed by sub-region
- Animals (5): Small ruminants followed by cattle and poultry
- Fisheries (2): Marine fisheries was at the top
- Natural Resources Management: Water, followed by soils, range, ICM, and biodiversity
- Socioeconomic and policy
- Technology dissemination, marketing/commerce/trade, post harvest technologies, quality and value addition, institutional policies, gender and impact assessment
- Crosscutting: Human resources, capacity building, information technologies, biosafety, IP issues, indigenous knowledge, and crisis and risk management (last)
- Methodologies and approaches: Strengthening regional fora, networking, participatory research, GIS, integrated farming systems (last)

ASIA REGIONAL DOCUMENTS

APAARI

Asia-Pacific Association of Agricultural Research Institutions (APAARI) 2002 "The Sixth Executive Committee Meeting of APAARI and Expert consultation on Regional Priority Setting for Agricultural Research for Development in the Asia-Pacific Region." Proceedings Document (12-14 November 2001). Bangkok, Thailand.
http://www.apaari.org/documents/publications/6excom-proceeding.pdf

Institutional Background: APAARI is arguably the oldest and most well developed of the regional organizations. It has had FAO sponsorship for many years. Its member organizations (NARS, IARCS, NGOs, and ARIs) include several highly advanced National Agricultural Research Councils.

Consultation Process: A major initiative in priority-setting was carried out through "Expert consultation" with broadly consultative activities in:

- ***West and South Asia*** (reported at ICRISAT, Patancheru, 5-7 July, 2001)
- ***East and Southeast Asia*** (IRRI, Los Banos, 27-28 June, 2001)
  - "Research Priorities in Agriculture, Forestry and Fisheries Sectors in the Pacific Region (Fiji, 29-30 October, 2001).
  - The Peoples' Republic of China, while not an APAARI member, was in attendance and reported a general statement of interest.

A wide range of stakeholder participated in these consultations. The Asia-Pacific Region was synthesized in the Bangkok meeting, reported here. The South Asian sub-region had the most analytical approach of the exercise.

OVERVIEW

WEST AND SOUTH ASIA

Major agricultural development challenges in the region include: agricultural growth and diversification for food and nutritional security, sustainability of agricultural systems, enhancement of income opportunities for poverty alleviation, and improving competitiveness of agriculture with focus on small-holders. Appropriate indicators for these development challenges were identified and used for prioritization of research portfolio. The first three challenges were better captured in assessing commodity and ecosystem priorities, while the last was more appropriate for identification of priority research themes.

For South Asia as a whole, commodity priority groups are cereals, livestock, horticulture, cash and plantation crops, oilseeds, pulses, root and tubers and fish in that order. The commodity priorities were checked for their sensitivity by considering growth in food and feed demand for the commodities. The results showed a minor shift in priority score from cereals to livestock and horticultural products.

The priority commodities for West Asia include livestock, cereals, fruits, and vegetables in that order, which are very similar to the arid ecosystem of South Asia. Therefore, West Asia was considered along with Arid and Semi-Arid ecosystems of South Asia for identification of priority research themes.

PACIFIC REGION

The objective of the priority setting exercise for the Pacific sub-region was to identify and assess research problems and/ or research issues within specified areas of research opportunities, which are then prioritized within each of the sub-sectors. Ultimately, this should contribute to the overall economic and social well being of communities in the countries and the Pacific sub-region.

The workshop synthesized the regional research issues into following six groups:

1) Crops,
2) Livestock,
3) Forestry,
4) Fisheries,
5) Natural Resource Management,
6) Crosscutting issues, especially in the areas of information, economics, and policy.

The principle objectives for work in the crops sector are the development of higher nutritional value crops to provide more balanced diet/nutrition and the production of high quality and valued (value added) produce/ by-produce. The priority assessment indicates that value for adding and markets/marketing are the two issues warranting strongest emphasis in research. The high potential impact but moderate feasibility of plant genetic resources and pests and diseases suggest that ways of increasing research capacity in these areas should be examined. Selective emphasis should be accorded to drought and salinity tolerance, accessibility, and utilization, because of their low feasibility, arising by low likelihood of adoption. Integrated crop and livestock faired moderately and need objective consideration. Other objectives include increased yields and productivity per unit of time and resources; off-season or prolonged crop production for vegetables, fruits, biological control, and management of pests and diseases, and the crop-livestock integrated systems, especially in PNG.

SPECIFIC RESEARCH RECOMMENDATIONS

WEST AND SOUTH ASIA

For arriving at the research priorities, constraints and opportunities for each of the ecosystems were considered in detail. It was pointed out that Arid, Semi-Arid and Humid ecosystems of South Asia, and West Asia are harsh and risk prone production systems with rapid degradation of land and water resources. Similarly, Irrigated Sub-Tropics ecosystems face degradation of land, depletion of groundwater, and declining profitability, threatening sustainability of the system. The mountains are constrained by inadequate infrastructure development, and migration of work force. Some of the opportunities considered were diversification towards livestock and horticultural crops, precision farming, value addition and market integration, and scope for improving water use efficiency. These constraints and opportunities along with scientific advances were considered for assessment of priority research themes. Specific criteria considered at this stage were likely impact of a research theme on improving efficiency, sustainability, and competitiveness of production systems, and alleviation of food insecurity and poverty. The chance of research success was also given due weight. There are some research themes of common interest of all stakeholders and these themes cut across all the ecosystems. The common themes are: mapping of poverty and degradation of natural resources; soil and water management; diversification of systems; commercialization and post-harvest processing; market integration and trade liberalization; sustainable seed and technology transfer systems; and risk management.

PACIFIC REGION

The principle objectives for livestock research are to improve nutrition (animal and human) and productivity using locally available feed ingredients and reduce the impact of animal wastes on the environment and integrate animal wastes into crop production systems. Feed formulation and animal waste management received the strongest emphasis. The feasibility of making progress in the control of livestock diseases and genetic improvement was assessed as being relatively high. The high potential impact of zoonoses was recognized although the feasibility was assessed as low. Human resources, husbandry practices, and integrated systems faired only moderately on both impact and feasibility criteria. Other objectives include establishing the disease status and identifying the role of livestock in integrated farming systems and developing management and husbandry models suitable to various areas.

The overall goal for research in the forestry sector is to provide benefits from improved forest management and conservation. In the forestry sector, timber utilization and management felling and cutting cycles are the issues requiring the strongest research emphasis, having high potential impact and feasibility. Forest health, agro-forestry, and integrated land use were all assessed to have high potential impact but with concerns for the feasibility of making progress. Non-timber forest products appeared with modest impact but high feasibility. Reforestation and forest product marketing faired moderately on both accounts.

The principle objective for research in the fisheries sector is to develop local alternative feeds and feeding systems, which can fatten fish with minimal by-products. Therefore, feeds and feeding was assessed as having high potential impact and feasibility for the fisheries sector. Reef fisheries status assessment was regarded as having the highest potential impact. The feasibility of developing "turnkey" aquaculture systems is high although the potential impact on the fisheries sector is moderate. Aquatic bio-security faired only moderately on both the counts. Other objectives include developing appropriate aquaculture for the Pacific; providing information for communities and Governments on the exploitation and potential of natural reef fishery resources; certifying quality for sustainable export markets, especially in Asia; developing the capacity and policies to handle the potential threat of disease transfer and assess the impact and mitigate the effect of introduced species; integrate the separate community and government systems of traditional and national laws, and set reference points for setting targets for maximum catches in reef fisheries.

The principle objectives for the NRM sector are to establish an integration mechanism and develop sustainable integration between bio-physical, economic, socio-cultural, and environmental factors. The NRM issues were assessed as either medium or low, the region being with limited research capacity in this area. Soil fertility, water management, and integrated NRM were all assessed as having high potential impact. Farming systems research appeared to be moderately fairing. It is interesting to note the relatively high importance accorded to waste management among the livestock issues as opposed to other NRM issues.

The principle objective for research on the crosscutting issues are to build capacity to assemble, access and use information and overcome the lack of information on the economics of production and marketing, and understanding of markets and supply and demand responses. Crosscutting issues included information and packaging, access and use. Production and marketing economics were both assessed as having high potential impact and feasibility. NRM policy, supply and demand analysis were also assessed as having high potential impact. Issues such as policy research into import-export, biodiversity, risk management, and treaty incompatibility emerged as having only moderate impact and low feasibility of accomplishment.

EAST AND SOUTH EAST ASIA:

The multi-faceted and inter-connected nature of the regional issues-food security, loss of biodiversity, widespread poverty, and unsustainable extraction of natural resources, and the like, necessitates consolidation of efforts at the regional and the sub-regional levels of the agricultural systems. Another important observation based on the past experience pointed to the inefficiencies and ineffectiveness of the independent and fragmented national research systems working on challenges of agricultural productivity and sustainability. The end in view was to build on the strengths and milestones of some NARS while enhancing capability of the weaker ones.

Four major priority areas on which consensus emerged were:

1. Food security related issues of increasing production, quality, and competitiveness; addressing bio-safety aspects, and enhanced application of cutting edge technologies.

2. Natural Resource Management with focus on conservation of biodiversity, management of soil and water and promotion of IPM and IPNS.

3. Increasing Farmers' income /Rural Economy through improvements/development of processing, distribution and marketing infrastructure and enterprise development.

4. Support for the R&D efforts in the form of proper initiatives on HRD, enhanced use of ICT for information sharing and strengthening the policy advocacy on new issues such as APRs, GMO, etc.

Several sessions of discussion and analysis led to the following summary for the Asia Region as a whole. The ranking of priorities change by sub-region, and by agroecology within subregion:

ASIA-PACIFIC REGION (CONSENSUS SUMMARY)

1. Natural Resource Management
   - 1.1. Integrated NRM and Integrated Crop Management (ICM)/IPM
   - 1.2. Policy development and institutional issues related to NRM
   - 1.3. Watershed management
   - 1.4. Land management and soil fertility
   - 1.5. Rehabilitation of degraded and marginal lands
2. Genetic Resources Enhancement and Agrobiodiversity Conservation
   - 2.1. PGR conservation and improvement
   - 2.2. Livestock selection and improvement (includes fisheries)
   - 2.3. Microbial functional agrobiodiversity
   - 2.4. Bio-safety issues/policy/GMOs/IPRs
3. Commodity Chain Development (Linking Farmers to Markets)
   - 3.1. Commercialisation, marketing and trade
   - 3.2. Policy – International agreements
   - 3.3. Input/supply and demand analysis (industry and macro level)
   - 3.4. Production and marketing economic analysis (firm/farm and micro level)
   - 3.5. Value adding
   - 3.6. Competitiveness
   - 3.7. Product/quality improvement and standards
   - 3.8. Quarantine and bio-security
4. Meeting the Protein Demand of a Growing Population (Through Animals)
   - 4.1. Feed resources: fish, poultry, ruminants and non-ruminants (forage, pasture, fodder, grain, constituted feedstocks, and crop residues)
   - 4.2. Disease management (poultry, ruminants, non-ruminants, aquaculture)
   - 4.3. Production systems (crop/livestock, aquaculture, mariculture)
   - 4.4. Waste management and by-product utilization
5. Meeting the Protein Demand of a Growing Population (Through Plants)
   - 5.1. Grain legume productivity improvement

5.2. Legumes in farming systems

5.3. Quality and nutrition improvement (human)

5.4. Food safety: aflatoxins and anti-nutrition factors

6. Tree and Forest Management for Landholders

6.1. Natural forest management:

- Harvesting regime and regeneration
- Cutting cycle analysis

6.2. Forest plantation, productivity, and health

6.3. Agro-forestry in production systems

7. Crosscutting Issue: Information Management for Agricultural Development

7.1. Packaging, access and use: Research, methodologies and modalities

8. Crosscutting Issue: Capacity Building

8.1. Human resources development

8.2. Institutional development

- Research management, stakeholder management
- Technology transfer facilitation

8.3. Research policy development:

- Food insecurity and poverty mapping

ZEF

Campbell, K., A. Morgounov, J. Henson, and T. Lumpkin 2004 "International Cooperation for Agricultural Research in Central Asia and the Caucasus (ICAR)" in Ryan, J., P. Vlek and R. Paroda (eds) *Agriculture in Central Asia: Research for Development.* Proceedings of a Symposium held at the American society of Agronomy meetings, Indianapolis, Indiana, Nov, 2002. Sponsored by the Center for Development Research (ZEF), Bonn, Germany, and ICARDA.

Institutional background: The ICAR is a US-funded project with the goal of promoting food security, economic growth, and political stability for the people of CAC. Its programs started in 2002. The intent is to provide scientific expertise in plant germplasm, microbial diversity, soil science, conservation agriculture, and water utilization to improve food security and sustainability of cropping systems. The USDA-CSREES is the primary funding agency.

Priorities: In 2002, two planning meetings in Tashkent, Uzbekistan, and Tbilisi, Georgia arrived at the following priorities which guide research direction:

- Agronomy-conservation tillage: soil fertility, erosion control, permanent beds, increasing yield potential, water use efficiency
- Integrated pest management: weed control, insect control
- Alternative crops: forages, oilseeds and legumes
- Plant breeding: winter wheat, barley, maize, crosses with wild relatives, yellow rust resistance, grain quality, drought resistance, low-input agriculture
- Early generation seed production: foundation seed production, early generation trials
- Economics and marketing: economic assessment of new technology, establishment of grain quality standards, credit to farmers, economics of water use.
- Conservation of biodiversity: gene bank establishment, collection expeditions

ICARDA, WORLD BANK, AND GOVERNMENT OF EGYPT

ICARDA, World Bank, and Government of Egypt 2003 "Consultation for the CWANA region on the Proposed International Assessment of the Role of Agricultural Science and Technology in Reducing Hunger, Improving Rural Livelihoods, and Stimulating Environmentally Sustainable Growth" (25-26 February) Cairo, Egypt. Organized by ICARDA, The World Bank and the Department of Agriculture and Land Reclamation, Egypt. http://www.agassessment.org/pdfs/cairo/cairoreport.pdf

Institutional Background: The World Bank initiated a global consultative process on a proposed international assessment on how agricultural science and technology can help reduce hunger and improve rural livelihoods over the coming decades at WSSD in Johannesburg (see above, documents on International Agricultural Assessment).

Consultation Process: To ensure that the assessment is demand-driven, owned by all stakeholders, and targeted to well-defined user audiences, the World Bank initiated a series of regional consultative workshops. The objectives of these workshops are to develop an appropriate authorizing environment for an assessment and to determine the scope, objectives, and value of an international assessment. Over 100 people attended the Cairo consultation including World Bank staff, rural development specialists, and other professionals from national agricultural research institutions, government ministries, civil society organizations, sub-regional organizations, the private sector, farmer associations, and the international agricultural research centers active in the CWANA region.

OVERVIEW

THE CWANA REGION

As part of the efforts of the International Centre for Agricultural Research in the Dry Areas (ICARDA) in agricultural research and development for Central and West Asia and North Africa (CWANA), an inventory of the resources in the regional NARS is available (ICARDA, FAO, AARINENA, and CIHEAM 1999) and more recently a comprehensive priority setting exercise for agricultural research for the Central and West Asia and North Africa (CWANA) region has been undertaken with the sub-regional organizations, AARINENA and the CAC-Forum (ICARDA 2003). Many of the findings of these two initiatives have been confirmed recently in the UNDP report on the Arab countries (UNDP 2002). The above mentioned reports indicate that in the WANA region an estimated 70 percent of the poverty is in rural areas even though only some 43 percent of the total population lives there. Despite the large dependence of the rural population on agriculture there is a declining emphasis on agriculture and rural development. In addition the region is facing a number of converging trends that threaten the future livelihoods of the poorest sector of society. These include:

- **Water scarcity:** The region is already one of the most water scarce in the world and this is predicted to worsen markedly over the next 25 years. As a result the food security situation will also likely worsen. The region now imports grain (about 51 million tons per year in 1998-2000). Fifteen of the countries of the CWANA region already below the water "poverty line" of less than 1,000 cubic meters per person per year, and hence integrated approaches to water management are urgently needed that consider water demand management, water use efficiency of different production systems, water resource allocation, and policy packages.

- **Population growth rates:** The region is characterized by the second highest population growth rates on the planet, with some countries in the region growing at 3.5 percent per year.

- **Land degradation:** As much as 45 percent of the total land area dedicated to agriculture and rangeland is experiencing some form of land degradation, thus reducing the already low productive potential of the land.

- **Global climate change:** The region is projected to become warmer and drier with reduced crop productivity, threatening the region's food security and place increasing pressure on the food production systems and natural resource base.

Achievements by the Arab region on the Human Development Index (HDI) have been lower than the world average over the last decade, not because of income poverty, but rather because of a poverty of capabilities and opportunities, particularly in terms of women's empowerment, and knowledge and the quality of education (UNDP 2002). The Arab countries have the lowest level of Information and Communication Technology (ICT) in the world with only 0.6 percent of the population using the Internet. Therefore in the CWANA region particular efforts are required to increase human and social capital and knowledge so that the region can develop its own capacities for agricultural research and development and be better equipped to take advantage of existing and new developments from outside the region. The earlier report by ICARDA provides a synthesis of these requirements (ICARDA, FAO, AARINENA, and CIHEAM 1999).

The Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA) and the Central Asian and Caucasus NARS forum, together with ICARDA, have recently completed a widespread consultative prioritization exercise for agricultural research and development in the CWANA region (ICARDA 2003) and concluded that strong research-extension-development linkages constitute the surest and most efficient path to agricultural development and hence rural development in the region. This exercise gathered opinions from a wide range of organizations and institutions that included NGOs, the private sector, universities, investors, and donors in a four-step process involving an inventory of CGIAR activities in the region, a questionnaire, sub-regional brainstorming meetings, and culminated in a CWANA regional meeting held in Aleppo in May 2002. The result of this exercise is an in-depth assessment of the priorities for agricultural research and development for commodities and natural resource management. It forms the basis of the necessary focus on agricultural science and technology that should be the foundations of any rural development in the CWANA region.

ISSUES RAISED IN THE CONSULTATION

Participants agreed on a need to identify where science has divergent views such as the issues surrounding biotechnology, with a need to bring these into public debate as well as address them in the assessment.

Questions remain on how to involve civil society in the assessment, and how to include local and regional perspectives and expertise. The very divergent groups, particularly those from civil society, had significant difficulty in achieving effective dialogue on several issues at the consultation.

Efforts should be made to assess both the potential and risks of new S&T. Dialogue should address the social, political, and economic dimensions, the impact of global changes, focus on poverty and sustainability, access to and transfer of technology, incorporate indigenous knowledge and address the North-South divide, regional cooperation, and capacity building.

SPECIFIC RESEARCH RECOMMENDATIONS

BIOTECHNOLOGY

Participants stated that more research is required on the risks and benefits and biosafety (health and environment) aspects of biotechnology and the results clearly explained to the public at all levels. Biotechnology needs to be directed to the needs of the poor by focusing on the "orphan" crops and on the problems of the marginal dry areas that the private sector usually ignores. In some regions, biotechnology can be used to address the issue of poor quality seed and the introduction of improved materials into the artesian or local seed sector.

POLICY ARENA

There is a need to strengthen national policies and a need to bring in all aspects of the potential of modern science and technology via greater advocacy. In the policy arena, there is a need to focus on how the private sector can be engaged more in addressing issues of the poor. What changes are required for an enabling environment where the private sector could be greater engaged and encouraged to formulate public-private

partnerships? Governments should adopt a strategy to encourage these alliances. Currently it is recognized that the scientific community is paying insufficient attention and input into policies for science.

CAPACITY BUILDING

Participants agreed capacity-building is urgently needed in the CWANA region for agricultural S&T. It was recognized that S&T will not advance in the developing countries without a strong capacity base. How can science and the need for a strong base be promoted in the CWANA countries? The participants agreed that there is a need to send clear messages to governments, the private sector, and the consumer. More effort needs to be made in order to empower farmers to direct the research via participatory action research, more farmer-to farmer exchanges, farmer field schools, etc.

The quality of education has been highlighted as a major issue in the CWANA region at primary, secondary, and tertiary levels and one, which urgently requires addressing. Incentive grants are required in order to encourage people into higher and further education and to reverse the "brain drain" in the region. International exchange schemes help close the gap in knowledge in S&T. Greater linkages of education with the institutions involved in S&T will be particularly important. Rewards and salaries for scientists in the region are generally low with the result that there are little or no incentives to a career in agricultural S&T. This will probably remain a problem until the agricultural sector becomes wealthy enough to pay for research and extension services and/or greater investments are made by the public sector.

INSTITUTIONAL ISSUES

Issues raised under this topic included what type of research and extension is needed to improve nutritional security, reverse natural resource degradation, and increase the income of the poor. Institutions need to collaborate more and prevent the fragmentation of efforts via greater regional and international cooperation in science and technology using networking, consortia, joint projects, and greater linkages to international conventions and debates on negotiations and trade barriers.

Institutions should become learning organizations encouraging "constructive subversion" – encouraging and not crushing new ideas from the young.

KNOWLEDGE MANAGEMENT

There is an urgent need to exchange and share knowledge in the region but there are a few mechanisms to achieve this. Efforts should focus on how to provide the end user with the appropriate knowledge that includes technological, financial, and marketing information in order to help alleviate poverty. Different media and types of knowledge are required in order to reach all sectors of agriculture.

In this respect, there is a role for knowledge management of S&T in stimulating local private industry for seed production and processing, agro-industry, etc.

IPR

A clear need to protect the IPR of indigenous and local community knowledge was expressed, as was the need to separate ownership rights of scientists and others who develop innovations from the rights to use information for research purposes. The challenge here is how to put the pieces together in a balanced way taking into account the technical and human resource constraints, the legislative issues, and public perceptions of IPR. An overly stringent IPR process will stifle the development of the private sector particularly in developing countries that need to close the gap with developed countries. A lack of cooperation among the developing countries was highlighted as an obstacle on IPR issues. The costs of adequately dealing with IPR could be prohibitive for many countries and there was the recognition that many countries cannot field teams of experts at negotiations thereby weakening the bargaining positions.

LOSS OF BIODIVERSITY

The region is characterized by dry lands and these regions have important sources of biodiversity associated with drought and salinity tolerance that need to be protected and conserved. At the same time, there is a need to increase productivity and diversification of the production systems. Therefore, there is a need to study and

promote the concept of eco-agriculture, i.e., the encouragement of biodiversity and agricultural production within the same landscape.

WATER RESOURCES AND THEIR MANAGEMENT

Because the region is the most water scarce in the world a particular focus needs to be made on declining water resources for the agriculture, industrial and domestic sectors and on increased water use efficiency at all levels. Re-use of water will become an increasingly important aspect of water management with accompanying health and social considerations. Hand in hand with increased water use efficiency will be the development of more drought and salinity tolerant plants by both conventional breeding methods and new biotechnologies, and more efficient irrigation systems. Increased efforts on improving water use efficiency should accompany efforts to diversify production systems with new crops and rotations that are more conservative in water use rather than a focus on productivity *per se*.

OTHER ISSUES ON NATURAL RESOURCE MANAGEMENT

Central Asian delegates were particularly concerned that soil and land degradation be addressed in their region. This is also reflected in the ICARDA-led priority setting exercise for the CWANA region that ranked soil degradation second after water in the list of priorities for natural resource management. Perverse incentives that damage the environment (e.g., fertilizer subsidies) should be removed and more environmentally friendly technologies encouraged.

SUMMARY OF S&T ISSUES

The following core S&T questions were viewed by participants as high priority issues:

- The potential of current and future technologies, by region, to produce crops, livestock, fish, forests, biomass for energy, commodities, with the required nutritional value in an environmentally and socially sustainable manner;
- The potential to reduce post-harvest losses and minimize waste;
- The potential to improve crop traits, e.g., drought, pest, salinity, and temperature tolerance;
- Whether animal protein is part of solution or problem;
- The biophysical barriers to agricultural production and how indigenous knowledge can improve the approach these barriers;
- How much energy and water will be needed as agriculture expands to meet demand: what the potential is for improving energy and water use efficiencies in agriculture;
- How can we ensure biodiversity in areas where production must be increased;
- The potential to deliver pharmaceuticals through agricultural products safely and reliably
- How information technologies can assist producers;
- How to create an environment for countries to share technology success stories; what is needed to eliminate technical and human capacity gaps in ICT.

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Institutional Background: Chemonics International is a consulting firm with expertise in agricultural and natural resource management topics. It holds many USAID contracts.

Consultation Process: A desk study, with document review and interviews with senior science and technology leaders, donors and sector institutions, and USAID staff.

OVERVIEW

> "Throughout Latin America and the Caribbean (LAC), globalization and related trade expansion forces converge to form previously unimaginable farm and rural sector links driven by regional and global markets. In this setting, if innovative, demand-driven knowledge systems are introduced, previously under-exploited resources have the potential to stimulate broad-based economic growth that reduces poverty. Generally speaking however, this unprecedented potential is not joined with the appropriate, Science and Technology (S&T) program. To confront this fundamental need, this paper discusses: 1) topic rationale, 2) changing dynamics and responses, 3) corresponding policy and institutional recommendations, and 4) suggested activities that USAID may use to stimulate urgently needed country and donor-level responses."

THE FUNDAMENTAL PRECEPT

In today's, trade-driven era, country-level economic growth is linked to: 1) improving factor productivity from market-driven knowledge systems; and 2) implementing science-based regulatory and food safety requirements such that external market access is regularly gained. The ability of S&T services to contribute to rural growth, especially in the case of poor farms, can ameliorate the negative and enhance the positive effects of trade liberalization (Tabor 1995). The processes for introducing new species and/or new varieties, cultural practices, processing technologies, and knowledge tools that have been developed via science-based basic, strategic, and applied research linked to and closely related to technology transfer mechanisms is essential to increasing rural prosperity. This is particularly so for higher-valued activities that inherently generate farm and off-farm employment and new income streams that generates broader rural-based services and products.

REVIEW OF HISTORICAL TRENDS IN AID TO LAC

A summary of the AID trends is given. Foreign assistance to the basic commodities has had a significant (usually more than 20 percent per year) payoff.

LAC agriculture is now making sub-sector shifts away from the commodity mixes prevalent during the old import substitution era which focused on self-sufficiency towards investments producing market-led, higher-valued commodities with greater value added potential. During the four decades of import substitution, government-led but with commensurately large donor support, was directed to the expansion of the "National Agricultural Research Institute (INIA) models. These INIAs lacked strong links with the private sector, stakeholder producer associations and agri-business. They generated little support base and seldom confronted national competitiveness issues. Donor support likewise has decreased. According to a comprehensive worldwide review of agricultural S&T programs done under a joint USAID /World Bank study, from 1952-96, agricultural research support peaked in 1987 at $220 million (Alex 1997). Though no regional breakdowns are available, from this study about $20 million was for LAC's INIAs in 1987. This was supplemented by considerable PL 480 commodity support to cover essential host county counterpart support for local costs. USAID levels also declined notably such that by 1996 (the last time detailed data was available), the INIA support level worldwide was $6 million, from which an estimated $1.5 million was for LAC's INIAs.

Some dramatically different S&T-related issues affecting rural prosperity are emerging:

- More dynamic rural sector and national level multipliers now possible. In response to macro reform, markets and urbanization, and global competitiveness, "agriculture" has shifted strategically from a production focus to a more food and agroindustrial system.

- Significant numbers of producers are now vulnerable and will be challenged increasingly: With trade liberalization, a large number of producers will need to diversify or confront farm enterprise crop/activity adjustments, or if not, continue to migrate to already crowded urban centers.

The new era S&T agenda is more expansive: To generalize, except in the case of Chile and maybe along certain commodities such as asparagus in Peru, cut flowers in Colombia, snow peas in Guatemala, and a variety of nascent NTAE experiences in Central America, the fundamental S&T support systems are lacking.

What this all means in terms of S&T capacities? During this critical crossroads period, new, market-driven S&T support system to generate knowledge and efficiency provide an indispensable element to forge much needed economic, social, environmental, and political wellbeing In today's changed environment, well-regarded LAC rural growth strategists conclude that in many areas the promotion of agricultural growth should be a first priority in support of rural development, particularly high value-added crops and farm enterprise activities produced for agro-industry, non-traditional exports, and labeled products for niche markets. Furthermore, within this setting, improved technologies become important sources for agriculture and for poverty reduction.

CREATING A MORE PRO-RURAL/PRO-COMPLEMENTARY S&T NATIONAL COMMITMENT

In today's era, national-level investments in science and technology become an essential, national political priority.

Formulating a national, new era S&T program frame: Today's diverse and complex technology demands surpass the "national" commodity structure that supported "production–driven" systems of earlier programs. In this setting a new, Rural-Based Knowledge System focusing on three priority, interrelated themes becomes critical:

- *Competitiveness*: Increasingly, country-level competitiveness will be determined on specific points related to commodity specific market share, comparative costs of production, relative export advantage, and related competitiveness support (Blackman, Shui, Cramer and E.J.Wailes 1992).

- *Natural Resources*: Under the new economic environment, the natural resource. base to include soil, forest, genetic, and water resources becomes the base from which current and future growth prospers.

- *Rural poverty:* Since most of the affected are the highly vulnerable cereal producers, they will probably be in a position to employ an interim land alternative strategy to maximize family subsistence needs on smaller land units.

Facilitating the new era institutional model: To generalize, the INIA institutional framework does not serve the demands now required. New era public good issues need to be defined and promoted to generate private sector political and financial support. While this national-level support base contemplates this activity and designs the new mission and support elements, a broader array of complementary international support experiences should be considered. These include; the range of international crop, problem, and discipline specific global networks organized by the CGIAR, USDA, and also under USAID's Collaborative Research Support Program (CRSP) and the reformulated support program evolving from USAID's "New Agricultural Strategy" exercise now under way. Some NGOs and consulting company experiences provide new front line adaptive research and technology outreach experiences to provide the interim experiential base until more sustainable institutional bases are in place.

SUGGESTED ACTIVITIES:

Conceptualize potential product lines and outline support requirements around real and potential "comparative advantages:" The smaller and medium-sized countries are particularly vulnerable due to their limited S&T capacities and in some cases, limited opportunities. They will require assistance to conduct the necessary assessments of market opportunities, agronomic potential, and cost factors to help guide assess their future strategies. Based on available data and in consultation with major agribusiness and country-level commodity leaders, an effort should be made to sketch out and analyze the prospective potential "winners."

Initiate a participant training program to form a new era critical cadre of MS and selected Ph. D. personnel: There is a great dearth of technical skills that in a selective way, must begin to be addressed. In addition, local applied, vocational training in select areas will also become a requirement

Develop an outreach program for the utilization of improved technologies for basic food producers as a crucial "Alternative Strategy: Most of LAC's small producers are maize, or other cereal producers. For this large grouping, a particularly daunting challenge prevails as tariff reduction exposes many to cheaper producers. Competitiveness issues become real. For this group, alternative employment options will be extremely limited for those displaced until a broader range of employment activities and a more robust economy is in place. In the meantime, at least subsistence needs must be confronted while many of these producers, explore other land use pursuits to include livestock, tree crops, or mixed farm/non-farm activities.

SPECIFIC TECHNICAL AREAS OF INCREASED IMPORTANCE:

Biotechnology: There is considerable attraction to biotechnology for its opportunities as a positive crop improvement tool to address multiple needs. Important biotech products include pest resistance, improved yield, biotic tolerances, nutritional benefits, and reduced environmental impact. Less than 29 percent of the biotechnology trial work has been done in developing countries. In LAC, Argentina is the unique world leader (with the US and Canada), being the second largest exporter of genetically engineered crops, almost all of which is soybeans, more than 90 percent with 5 percent for maize. Both GMO production systems were developed with leading tans-national companies (Burachik and Traynor nd). The other LAC GMO using countries are no where close to Argentina's dramatic expansion over the last 10 years.They include Mexico, Venezuela, Colombia, Bolivia, Brazil, and Uruguay (New York Times 2001). While GMO agricultural products in LAC hold "promising results for agricultural productivity," this potential is constrained by the universal concerns associated with human health safety and affects on bio-diversity (Diaz-Bonilla 1999). This wide spread fear and concern requires that highly professional national-level biosafety systems be in place for all insist that strict standards for safety related to human health and environmental must first be in place. In their absence, private sector biotech investments are reduced, local product sales limited, and product entry for exports is denied.

Food Safety: A review of the Congressional Research Service's regular Food Safety Reports reveals the increased importance the US places on food safety, due in part to the increased arrival of imported food products, preserved and fresh. This vigilance will become more serious in the context of the FTAA for as tariffs are dropped, science-based food safety inspection systems will be enforced. Food safety attention becomes much more complicated in the context of the emerging producer to processor to export to consumer "chain" with increased chance for contamination. In this setting, IICA's recent assessment concluded that in LAC there was a "different imbalance" as to the status of their institutional, regulatory, and technological capacities. This relates to installed capacities in terms of standard setting, and the relationship between national legislation and international regulations and their equipment and capacities. While they concluded that much progress had been made in the regulatory arena overall: 1) LAC countries play only a small role in international reference organizations; 2) risk analysis units either do not exist or are inadequate; 3) there is little interaction between the public and private sector; and 4) there is an absence of information and surveillance systems to support decision making" (IICA 2001).

In response to these dynamics it is important to note USADI/LAC's sub-regional program approach under the "Caribbean Agricultural Competitiveness Program." Beginning in 1998 and working through CARICOM, a series of technical support services to assist the Caribbean countries to respond to principals set forth in the

"World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures. Under this agreement, attention is directed to: 1) Hazard Analysis Critical Control Points (HACP) certification; 2) risk assessment analysis, legislation to strengthen surveillance, quarantine vet drugs , plant health, food control and quality, pesticides and toxic chemicals; and 3) Testing procedures and protocols to enforce standards. Considerable interaction has been done to expand this activity in Central American where dialogue continues. In the Andean region, however, little interest has been generated. In the context of the important gap this effort is addressing, minimal support to help foment large numbers of future trading partners with the basic tools to function—becomes a most worthy investment.

Animal and Plant Health: Though very much related to Food Safety, the focus herein is more on the prevention and eradication of pest and disease from crops and livestock as noted above. In addition, human health concerns, for example pesticicide residues form the other major food safety grouping. There are broad economic concerns for receiving countries of unhealthy animals or plants that might affect similar species or native fauna and flora. If not appropriately diagnosed and/or quarantined, they have the potential for causing considerable damage. On the animal health side, in LAC the principal concerns relate to foot and mouth disease, poultry influenza and Newcastle disease, and classic swine fever. For plant protection issues are much more extensive starting from the larger number of insect born plan diseases (IICA 2001). Rigorous, science-based public sector institutions conduct a standard series of activities related to clear health and trade policies and precise standards, technical audit and inspection mechanisms, and quarantine controls, and disease and pest eradication.

Information Communications Technology (ICT): Resulting from considerable advances in internet and electronic commerce and their application to the needs of the developing countries, exciting opportunities to provide new cost–effective knowledge systems becomes possible.

IADB

Inter-American Development Bank (IADB) 1999 "Strategy for Agricultural Development in Latin America and the Caribbean" Washington DC: Inter-American Development Bank.
http://www.iadb.org

Latin American economies are becoming increasingly successfully integrated into the world economy. However, growth has slowed and the proportion of agriculture in the total economy has changed little in recent years. Agricultural production still accounts for more than 25 percent of gross regional product and more over 40 percent of exports; in some countries such as Argentina, Colombia, Costa Rica, Haiti, Guyana, Nicaragua, and Paraguay, one or both of these indicators are considerably higher. In the rural communities poverty remains a major social and political challenge. Three countries – Brazil, Mexico, and Argentina – account for 70 percent of the total gross agricultural product in Latin America, equivalent approximately to that of the United States and Canada combined. Rural poverty is concentrated mostly among small-scale producers with very limited agricultural potential and landless persons.

Several lessons have been learned in the modernization process:

- Growth in the agricultural sector is a necessary condition for economic growth and for reducing rural and urban poverty.
- Agricultural and nonagricultural employment must be created in rural areas in order to reduce poverty. In addition, public investment in basic infrastructure is needed to improve production and quality of life in rural areas.
- An economic and institutional context is needed that promotes access to productive resources for broad sectors of the population, together with investment, and sustainable management of resources.
- Trade liberalization should be accompanied by productive investments and the development of infrastructure and technology to ensure greater economic efficiency and improve the well being of the rural population.
- A development strategy based on the competitive modernization of agricultural production requires an active process of technological innovation.

Priorities investments, objectives and key activities for the future are:

- Consolidation of **economic reform** programs and transition support – macroeconomic stability and fiscal balance; economic growth in the agricultural sector as well as the overall economy; consolidation of sectoral reforms; rural poverty reduction; and temporary support for restructuring the sub-sectors.
  - Support for highly indebted countries to **restructure their debt**, reduce the fiscal deficit, and improve macroeconomic management capacity.
  - Temporary compensatory measures for producers and consumers affected by economic liberalization, including transfer of resources, food aid, and productive support.
  - Development of **new market instruments** (**risk management, future markets**, stock financing, agricultural trade boards).
  - Support for private sector enterprises to channel resources to agriculture.
- State **reforms and services for the agricultural sector** – definition of agricultural and rural development policies and strategies, increase in sector competitiveness and modernization, greater efficiency in public services for the sector complementary with the private sector, decentralization and diversification of government activities, strengthening of national innovation systems, consolidation of

national systems of animal and plant health for the prevention, control and eradication of pests and diseases, and development of input and product markets:

  - **Reform** of the mandate and organization of **agriculture and rural development ministries**.
  - Formulation of appropriate policies and services to promote **technological development** and **animal and plant health**, to protect the health of the population and facilitate exports.
  - Strengthening of **public sector research**, encouraging participation by producers, enterprises, non-governmental organizations and universities in technological development and collaborative research, via competitive funds.
  - **Market information and export promotion** (including modernization and privatization of port facilities.
  - Technical support to improve **capacity to negotiate international trade agreements**.
  - Strengthening of the **medium-sized business** and **organized producer groups** to **produce and export quality products**.

- Development of **financial and capital markets and risk management** – Expansion of reliable, sustainable and low-cost financial services.
  - **Regulatory and institutional reform** to reduce transactions costs and informality.
  - Support for the **private banking system** to encourage it to expand into rural areas.
  - Support for emerging financial institutions (saving and loan cooperatives, NGOs, rural banks) engaged in providing financial services to the rural community.
  - Promotion of linkages between formal and informal credit institutions.
  - Promotion of **loans to rural micro-enterprises and the use of nontraditional technologies for implementing systems of collateral to broaden coverage**.
- Development of **land markets** – improvements in the efficiency of land markets, regularization of land tenure, or rural properties:
  - Modernization of cadastre, registration, and titling of rural properties.
  - Support for government efforts to facilitate the purchase of land by small-scale producers or to consolidate and emancipate the traditional agrarian reform projects.
  - Promotion of short-, medium, and long-term rural land leasing, enabling the negotiation and sale of lease deeds and facilitating their use as bank collateral.
- **Sustainable use of natural resources** – conservation and rational use of natural resources, more efficient use of water resources, integrated watershed management:
  - **Refurbishment and improved operation and administration of irrigation systems** and institutional strengthening to improve the **integrated management of water resources**.
  - Granting of **water property rights** to users and user associations to stimulate private investment and the development of small-scale irrigation projects or projects for refurbishing irrigation systems at the level of private users.
  - Promotion of the use of appropriate farming and livestock management practices.

- Reforestation practices in **high watershed areas**.
- Development of community capacity for action and investment in the sustainable use of natural resources.

- Development of **human resources** and rural infrastructure for production and improvements in the quality of life in rural areas – promote productive employment in poor rural areas, reduction of rural poverty, development of the rural economy, integrate marginal areas into national development, decentralization of government activities, expand opportunities for productive agricultural and non-agricultural development in rural areas, Development of the technical and managerial capacity of public and private agents.
  - Training to improve **labor market participation** in rural and urban areas.
  - Expand **public health** and **primary and secondary edu**cation services in rural areas.
  - Develop capacity for organized action by **farmers' groups**.
  - Develop **managerial capacity** in the **medium-scale agribusiness sector**.
  - Strengthening of rural municipalities and communities to carry out public investments, and promotion of private productive activity.
  - Investment in **communication routes (rural roads, highways, railways, navigable canals, electrification of rural markets).**

IICA

Inter-American Institute for Cooperation on Agriculture (IICA) 2004 "The state of and outlook for agriculture and rural life in the Americas" San Jose, Costa Rica: IICA.
http://www.iica.int/documentos/PEMI/SIT/

Institutional background: The Inter-American Board of Agriculture (IABA), which is the governing body of the Inter-American Institute for Cooperation on Agriculture (IICA), is recognized as "the primary ministerial forum within the Organization of American States (OAS) for analyzing and building consensus on policies and strategic priorities for the improvement of agriculture and rural life." IICA is located in San Jose, CostaRica.

Consultation Process: The Economic Commission for Latin America and the Caribbean (ECLAC), the International Food Policy Research Institute (IFPRI), the Tropical Agriculture Research and Higher Education Center (CATIE), the Pan American Health Organization (PAHO) and IICA contributed to the preparation of the report. Inspired by the "working together" approach, they provided working documents, made presentations at different for a involving the ministers of agriculture and their delegates, and participated in meetings in Santiago, Chile; Washington, D.C., and San Jose, Costa Rica.

OVERVIEW

The report did not outline the development of any specific research priorities, but did briefly mention those of others. It presents a rather massive collection of demographic, economic and development trends for agriculture in the South American and Caribbean Regions. Most current data are disaggregated by country, while projections, particularly for food, malnourishment, poverty, nutrition, production and value are taken from FAO 2015 projections of 2003. A broad range of agriculturally-related or interdependent development factors are presented, often by sub-region, including:

- Population
- Poverty
- Productivity (both gross and per worker)
- Trade balance
- The declining public research expenditures for agricultural research
- Discussion of the secondary problems of globalization and rapid supermarket growth, including the major problem of market access
- Concentration of land ownership
- Agricultural effect and amounts of remittances
- Income distribution under alternative growth scenarios
- Changes in food consumption to 2015

STRATEGIES OF DONORS FOR AGRICULTURALLY-RELATED DEVELOPMENT IN THE REGION (PP 21-22)

International financial institutions play an essential role in the development of the rural economy, given that the countries' own resources are insufficient. At present, the financial architecture that supports rural development and agricultural sector projects consists of agencies such as the IDB, the World Bank, IFAD, the Regional Development Banks and other governmental and private organizations. The elimination or down-sizing of state development banks and the channeling of credit through private banking institutions

made access to financing a critical issue, particularly for small and medium-sized companies or producers. This led a number of nongovernmental organizations (NGOs) and non-banking financial institutions to fill the institutional gap and assume the role of credit providers, focusing more on financing small businesses instead of isolated producers. With respect to the multilateral banks, after the internal evaluations conducted on the application of reform programs in the countries of the Americas, the IDB and the World Bank have redesigned their strategies in order to focus on promoting more efficient ways of combating poverty and developing the rural economies. In the specific case of the IDB, efforts have focused on programs to increase productivity, improve the efficiency of government programs in this sector and reduce rural poverty. The IDB is also promoting financing strategies to support the use of information and communication technologies. The agricultural sector represented approximately 43 percent of the total volume of resources allocated by the IDB to the rural area during the period 1992-2002, which reached US$ 7,000 million. Projected financing for the rural area in the period 2003/2004 is estimated at US$ 2,000 million. For its part, the World Bank has designed a hemispheric financing strategy that focuses on combating poverty and supporting sustainable development programs in the region. The objective of IFAD in Latin America and the Caribbean is to provide training "enabling the rural poor to overcome poverty."

The components of the IFAD strategy are:

(i) Empowerment of the rural poor;

(ii) Taking advantage of market opportunities;

(iii) Engaging in policy dialogue;

(iv) Partnerships and joint actions;

(v) Learning across regions and development of new products;

(vi) Gender issues;

(vii) Sustainable agricultural production and management of the natural resources.

In 2002, IFAD had an effective portfolio of 40 projects in 24 countries of Latin America and the Caribbean, for a total value of US$ 636 in IFAD loans and US$ 510 million financed by other donors, borrower governments and beneficiaries.

REGIONAL PLANS

The Puebla Panama Plan.(p. 20) In October of 2002, a Regional Technical Sub-commission, made up of CABEI, IDB, ECLAC, FAO, IICA and INCAE recommended the incorporation of a new component on Agricultural and Rural Development into the Mesoamerican Initiative for Sustainable Development. The Plan's agricultural component will place emphasis on projects in the following areas:

i) Food security and nutrition;

ii) Strengthening and integration of markets and regional agribusiness;

iii) Development and regulation of fisheries;

iv) Innovation and technology development and

v) Strengthening agricultural health, safety and quality.

SPECIALTY, HIGH VALUE PRODUCT OPPORTUNITIES (PP. 7-8)

Specialized or "niche" markets, such as the organic food market, show a tendency to grow faster than the broader, standardized markets. Among these, there is a growing influence of foods consumed by ethnic populations and specific social groups.

There is also a growing market for organic products. The market for those certified products, (supposedly) free of toxic substances and residues, has shown very dynamic growth levels in recent years, well above those of conventional agriculture (annual average growth of 25 percent, but variable according to the product). In the year 2000 retail sales of organic products were estimated to be worth approximately US$ 16,000 million reaching US$ 19,000 million in 2001, with consumers- especially those in more developed countries - willing to pay premium prices for products guaranteed to be prepared without the use of agrochemicals and free of toxic substances and residues.

In response to this growing demand, every day more producers are becoming involved in organic farming and the leading supermarket chains in North America and Europe are increasingly selling these products. Recent studies estimate that 23.7 million hectares in the world, distributed in over 400,000 farms, are planted with organic crops. In North America, Central America, South America and the Caribbean 6.2 million hectares were reported in 2003 and 120,000 farms with certified organic production. (IFOAM 2003).

New target markets for agricultural production and improvements in rural profitability include the sale of environmental services based on forest conservation for fixing carbon.

Others include the use of biodiversity to manufacture pharmaceuticals in Costa Rica, the isolation of a protein in Australia with applications in the cotton and medication industries, which is expected to generate large profits, and the use of farms for tourism activities in Chile, Spain, Costa Rica, and Venezuela. All are examples of new outlets for agricultural production and activities that provide opportunities to increase the profitability of the rural economy.

USAID

USAID 2003 "Rethinking Rural Finance: A Synthesis of the Paving the Way Forward for Rural Finance Conference" Michael Carter, Waters, E., with Branch, B., Ito, I., and Ford, C. (eds). Washington, D.C.: USAID (March 2004).

The conference *Paving the Way Forward for Rural Finance*, brought together academics, donors, practitioners, and development professionals to discuss successes and failures from past involvement in rural finance, and to explore creative solutions to the problems that constrain rural financial market development. Papers were presented. Discussion followed. Literally everyone of importance in the field participated. The conclusions in the synthesis paper were of the authors and did not necessarily reflect those of USAID.

In the 1980s, donors disengaged from rural finance as the result of hard lesson about the failures of targeted, subsidized credit and the consequent dependency of financial institutions on external sources of funding. Policies that were widely practiced did not prove successful. Government involvement in the management and implementation of rural financial systems was expensive and inefficient. The often political nature of loan programs, coupled with poor record keeping, meant delinquency was often overlooked. The result was a poor repayment culture and financial instability among lending institutions. Subsidized credit programs further undermined the institutional sustainability of financial institutions, distorted financial markets, and discouraged savings mobilization. Government interventions had a tendency to crowd out development in the private sector, and many people, particularly in rural areas, did not have access to adequate financial services.

No one doubts the importance of rural finance to achieving agricultural growth and poverty alleviation. Unlike earlier generations of rural finance programming, the approaches that emerged from the conference are *indirect* – they do not directly provide financial services. Instead they create an enabling environment and strengthen institutional capacity in a way that will induce the entry and evolution of competitive providers of rural financial services.

The emphasis of the conference was on what had been learned rather than what more research is needed. The conclusions were organized into five strategic programming areas that address the liquidity, risk, and savings constraints to economic growth in the agricultural sector and rural areas:

- **Mitigating Risk**. Creating instruments that protect financial institutions from some of the risk – specifically correlated risk and sectoral uncertainty/unfamiliarity by lending institutions – can stimulate lending. Such policies – such as index-based insurance and loan guarantees to stimulate private rural lending – can have multiplied effect as they open the space for the entry of new and more affordably priced financial intermediation services and help liberate rural households from risk constraints that suppress their own entrepreneurial activity.

- **Improving Information Access and Management**. Improving the infrastructure for collecting, processing and sharing information – such as new information technology and credit bureaus and credit scoring – can make smaller rural institutions more efficient and lower lending costs.

- **Diversifying Products and Services**. Effective rural financial markets should provide a wide range of services and products including lending, savings, leasing, insurance and transfers (e.g., remittances). The need for expansion of savings services – perhaps backed by deposit insurance – was highlighted as an element critical to both building institutional stability and meeting client needs.

- **Strengthening the Legal Environment**. The nature of laws that govern the financial sector, as well as the quality of the institutions that enforce those laws, will largely determine the shape and depth of the financial sector. Of particular importance are the laws and institutions that either facilitate or inhibit secured lending by influencing the ease with which agricultural and other rural assets can be used as collateral. The legal environment for secured lending can be strengthened through collateral widening

measures that codify land rights, promote legal reform for institutions, cooperatives and NGOs, and expand borrowing laws to increase the participation of poor.

- **Enhance Value-Chain Financing**. Input suppliers, processing firms, warehouses and other commercial actors provide critical financial services to small and medium rural producers. Enhancing interlinked rural finance activities and facilitating new services by these actors – such as producer associations, building market linkages with financial institution participation, and warehouse receipt lending – can expand access and ensure competitively priced financial services.

Four challenges were identified that could undermine programming and inhibit the growth of rural financial sectors:

- It is not automatic that addressing identified constraints will suffice to induce entry or contribute to institutional development and effectiveness.
- Legal reform is very complex. If the benefits of rural finance development are not clear to policymakers, it can be difficult to identify a champion or muster the political will for reform.
- People may not be willing to take advantage of additional financial services. In many rural areas, people distrust banks. Many people are unwilling to risk their assets for longer-term loans that would allow them to invest in production-enhancing technologies, etc.
- Many changes will require cooperation of financial institutions themselves. They can not be imposed from the outside.

SUSTAINABLE AGRICULTURE

Gregersen, H., J. McNeely, and J.P. Mueller 2003 "Sustainable Agriculture: A New Role for USAID."

Consultation Process: This report was prepared as a desktop review.

OVERALL FINDINGS

The authors took the following approach to the study:

The assessment has not included any field activities nor first-hand data collection, instead relying on available documentation, interviews with a wide range of stakeholders, and the experience of the panel.

In order to be most useful to USAID, the panel has focused especially on practical advice on how sustainable agriculture can become the foundation concept upon which all USAID agriculture-related investments can be based.

The panel has thus taken a very broad view of sustainable agriculture, to include the development of any practice which contributes to the sustainability of agriculture in general, rather than to narrow the definition to be more consistent with the USDA definition.

The panel states:

> Sustainable agriculture should not be conceived as "steady-state agriculture," but rather as a different, more dynamic and realistic way to think about how agriculture, broadly defined, can contribute to sustainable poverty alleviation and food security. It is a useful "lens" through which USAID can assess its own role in supporting agriculture worldwide. The focus should be on adapting to changing conditions, resilience in the face of such changes, conservation of biodiversity, developing new partnerships, and mobilizing new resources.

Congress defined Sustainable Agriculture as:

> An integrated system of plant and animal production practices having a site-specific application that will, over the long-term: satisfy human food and fiber needs; enhance environmental quality and the natural resource base upon which the agriculture economy depends; make the most efficient use of non-renewable resources and integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm/ranch operations; and enhance the quality of life for farmers/ ranchers and society as a whole" (Title XVI, Subtitle A, Section 1603).[47]

The panel added: "A sustainable agriculture must be ecologically sound, economically viable, and socially responsible. Furthermore, these three dimensions of sustainability are inseparable, and thus, are equally critical to long run sustainability" (Ikerd 1996).

The panel makes a number of general recommendations about how USAID should apply its approach to SA:

- USAID should consider "sustainability" as being a fundamental criterion for all its investments in agriculture and related sectors.
- USAID should develop a sustainability checklist to use in assessing any proposed agricultural investment, similar to current environmental assessments.
- USAID should strengthen local capacity and initiate local activities to carry out SA and NRM.

[47] Food, Agriculture, Conservation and Trade Act of 1990 authorizing the Sustainable Agriculture Research and Education Program [SARE], cited in NAL 2003.

- USAID should take a systems approach to science, looking at the actual combinations of seeds, pesticides and fertilizers in the ways they are used in practice, rather than looking at the inputs one by one. The reductionist approach is unlikely to be beneficial to the rural farmers. A systems view can bring farmers together with various kinds of scientists, leading to new structures and institutional forms of cooperation.

- USAID should follow the trend in sustainable agriculture to shift away from commodities toward systems of production, and from the level of the farmer's field to the landscape scale.

The Panel strongly supports a focus on helping the rural poor, for whom empowerment is key, particularly in the area of intellectual property rights and the ability of the poor to maintain their historical rights as well as to expand their access to innovative technologies.

For sustainable agriculture to be effective and efficient in contributing to poverty alleviation and food security, several more specific elements need to be considered, namely:

- Integration across spatial or geographic scales: landscape level considerations as well as field level foci are needed along with their integration in a program context;

- Temporal integration (consideration of links between present and needed future activities);

- Linkages with other sectors (e.g., transport, forests, education);

- Multi-disciplinary approaches, since sustainability depends not only on environmental conditions, but also on social, economic and political factors;

- Effective partnerships with scientists, ict specialists, and practitioners in developing countries;

- Effective training and education to ensure that when usaid teams terminate their activities, there are adequately trained local people to carry on with the institutions, activities and other innovations introduced through the usaid projects;

- Flexibility in application and use of the principles of adaptive management, recognizing that sa is a dynamic process not an end state, and uncertainties abound as one moves from one stage to the next.

- USAID programs that support sustainable agriculture include:

- **The SANREM CRSP**, which is the main vehicle for USAID funding of research related to SA and NRM. Started in 1992, over the next ten plus years, SANREM focused on:

  – Support of innovative, integrated, systems-based research that maintained the environment and promoted a greater understanding and integration of agricultural production systems within the socio-economic-political environment;

  – Provision of tools and methodology for assisting local to national decision-makers make sound decisions related to sustainable agriculture and natural resources, and

  – Development of an Information Management System that supports knowledge and network building activities world-wide.

- **The CGIAR centers,** another major avenue for environmentally-focused and NRM/INRM research.

- **Other** CRSPs, such as IPM and Aquaculture, which are described below in the other sub-sector reviews.

- **The Rural and Agricultural Incomes with a Sustainable Environment (RAISE) IQC**, a joint mechanism of EGAD[48] and ENV to support missions and bureaus devise and implement strategies and initiatives worldwide to promote sustainable, environmentally sound, employment, trade, investment and income opportunities. RAISE involves over 30 major environmental NGOs, business entities, consulting and university partners in three consortia, each managed by a major US consulting firm (Associates in Rural Development, Chemonics, and Development Alternatives Inc.). Its goals are to stimulate both:
  - Natural Resource-Based Industries (NRBIS) such as agribusiness, tourism, forestry, agriculture, and fisheries; and,
  - Community-Based Natural Resource Management (CBNRM).
- **The NRM InterCRSP project in West Africa**, which is led by the IPM CRSP and involves seven US Universities. A synthesis of four and a half years of fieldwork (Jan 2002) concludes that the project has:
  - Put in place a well functioning regional research and technology transfer (TT) infrastructure;
  - Developed three distinct models for facilitating regional NRM research and TT;
  - Enhanced local capacity and been instrumental in launching regional NRM technology adaptation and transfer activities and mechanisms.
- **The Collaborative Agricultural Biotechnology Initiative (CABIO),** designed to help developing countries access and manage the tools of biotechnology with a focus on improving agricultural productivity, environmental sustainability and nutrition. CABIO, utilizing USAID and other funds, supports collaborations between local, regional and international institutions, both public and private, including:
  - Biotechnology applications in agricultural research,
  - Creation of enabling policy environments (related to regulatory mechanisms, capacity strengthening and biotech policy);
  - Human and institutional capacity strengthening; and
  - Public outreach.

Within this initiative there are three major global programs: the Agricultural Biotechnology Support Project (ABSPII); the Program for Biosafety Systems (PBS) and the Biofortified Crops to Combat Micronutrient Deficiency activity. In addition, there are regional approaches related to biosafety and technology development, and country (mission level) programs in the three developing regions.

- **The Global Genebank Conservation Trust,** a plan to conserve genetic resources held by the CGIAR International Agricultural Research Centers together with germplasm held in key national genebanks.

SPECIFIC RESEARCH RECOMMENDATIONS

1. USAID should create an effective overall vision and strategy for supporting sustainable agriculture that includes:
   - Taking a long-term view;
   - Taking a holistic approach;

[48] The former USAID central bureau, Economic Growth and Agricultural Development (EGAD), now Economic Growth, Agriculture and Trade (EGAT).

- Linking across USAID sectors and organizational units;
- Introducing an output/impact culture in USAID projects; and
- Developing an adaptive learning and management mentality.

2. USAID should develop more effective mechanisms and a wider range of partnerships for supporting and coordinating sustainable agriculture investments.

- Coordinating USAID sustainable agriculture activities with those of other relevant agencies, both governmental and non-governmental;
- Establishing an NGO advisory panel;
- Continuing, and if possible, increasing USAID investments in SANREM and the CGIAR, to include NRM activities; and
- Requiring that SANREM III focus more on NRM in agriculture rather than on NRM itself, that it devote more efforts to scaling up, have greater policy input, and build better links to other CRSPS such as IPM, Soil Management, Livestock, etc.

3. USAID should continue to be involved in programs that focus on sustainable alleviation of poverty for poor rural populations

- Community-based programs
- Partner with ngos
- Decentralization of decision-making for developing countries concerning nrm
- Add non-agriculturally-related income activities
- Policy interventions to increase market access

4. USAID should take a stronger role in creating effective capacity for sustainable agriculture in target countries

- Strengthen local capacity through training, icts, and decision support systems;
- Support the BIFAD proposal to reintroduce university-level programs for education in NRM;
- Support mechanisms for farmer access to information; and
- Support innovative overseas programs for young US scientists.

5. USAID should increase its support for more effective management of water and watersheds in the context of sustainable agriculture, broadly defined.

- Sustainable land and water use, including agriculture, forestry, and fisheries depend on getting rid of policy distortions.

In addition, other issues are important:

- Supporting efforts to increase the efficiency of irrigation.
- Finding ways of recycling to agricultural applications.
- Seeking technologies that will raise water productivity

- Supporting breeding programs for drought tolerance in crops
- Supporting watershed management programs that help to stabilize water supplies and in some cases increase availability in otherwise periods of water shortages.

The general response of drilling more wells and building more dams is unlikely to be a sustainable solution to the problem, though water management structures will remain part of the technological response to food production.

ACQUACULTURE/FISHERIES

Review of the Status, Trends and Issues in Global Fisheries and Aquaculture, with Recommendations for USAID Investments, SPARE Recommendation to BIFAD: Sub-Sector Review of USAID Programs in Fisheries/Aquaculture, Washington, D.C., October 1, 2003.

This is the result of a three-person panel – two from universities and the third a consultant. USAID provided technical staff support and documentation. The panel was encouraged to talk with stakeholders. Draft findings were submitted to SPARE and to a formal public session.

The panel noted that fisheries are a source of employment for about 200 million people who depend directly upon ocean fishing for their livelihoods. Fish is the primary source of protein for some 950 million people worldwide and represents an important part of diet of many more. Globally, fish provide about 16 percent of the animal protein consumed by humans and are a valuable source of minerals and essential fatty acids.

Asia predominates in capture fisheries and aquaculture.

Increased consumption and production of fish will come primarily from the developing countries. Ocean fisheries are facing limitations due to overfishing. Near coastal fishing must deal with serious environmental problems. Inland fishing – in ponds and rivers has some potential for increase. But the future growth area is in aquaculture. Increased production from aquaculture has occurred primarily as a result of increasing feed inputs into ponds and other production systems. To reach potential, a much more comprehensive, science-based approach must be pursued in the future.

The following is a distillation of the findings with relevance to research of the SPARE Fisheries and Aquaculture Panel.

USAID needs to bridge the "digital divide" to develop solutions to fisheries and aquaculture needs in developing countries.

USAID should prioritize the improved management of coastal marine and inland fisheries (freshwater fisheries) by proving technical assistance to evolve innovative fisheries schemes in developing countries, including but not limited to, property rights, co-management, and the use of marine protected areas; plus assist in the development of more accurate and reliable fisheries data reporting systems.

USAID needs to substantially increase its support to develop more comprehensive, sustainable, ecologically and socially compatible, and economically viable aquaculture systems in developing countries that have the long-term goals of poverty alleviation and food security.

The priority areas for further applied research support include:

- Land, water and feed/nutrient use in aquaculture in comparison with other animal protein production systems;
- Sustainable intensification and non-consumptive water use in freshwater aquaculture production;
- Participatory management approaches to the comprehensive development of aquaculture ecosystems as sustainable means of rural development;
- Sustainable coastal aquaculture development, especially techniques that avoid user conflicts;
- Social and economic research to add insights into the adoption of aquaculture by poor rural households;
- Genetically advanced techniques for sustainable stock enhancement and ranching programs, plus the domestication., selective breeding, and genetic improvement of existing aquaculture species;

- Technologies to solve disease problems and innovative management solutions to improve the health of aquatic animals;
- Development of lost cost, non-fish mean based feeds;
- Training in the quality and safety of aquaculture products; and
- Research in making technologies cost-effective, including recirculating systems, and offshore aquaculture systems.

USAID should prioritize its assistance to capture fisheries and aquaculture activities that are more integrated, comprehensive, community-based, and use "systems approaches" such as ecological and integrated farming/fishing systems research and extension approaches – in both rural and urban settings.

Crosscutting issues – added by SPARE – included:

- Take a leadership role in integrating biotechnology techniques to broader science and technology efforts.
- Pay greater attention to markets, while not losing sight of research opportunities in important … resource management systems.
- Community-based approaches be considered when designing new programs and projects.

LIVESTOCK

IFPRI, Livestock to 2020: The Next Food Revolution, Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., Courbois, C., 2020 Brief No. 61, October 1999.

Report prepared by the authors as part of IFPRI's 2020 Exercise.

Unlike the supply-led Green Revolution, the "Livestock Revolution" is driven by demand. From the early 1970s to the mid-1990s, the volume of meat consumed in developing countries grew almost three times as much as it did in the developed countries. Developing-world consumption grew at an even faster rate in the second half of the period, with Asia in the lead. Milk production is growing even faster.

The increase in livestock production will require annual feed consumption of cereals to rise significantly. IMPACT (IFPRI's projection model) shows some impact on cereals' prices – maize prices in 2020 would be at most one-fifth above their present levels.

Far from being a drain on the food available to the poor, increased consumption of animal products can help increase the food purchasing power of the poor. Considerable evidence exists that the rural poor and landless, especially women, get a higher share of their income from better-off rural people (with the main exceptions found in areas of large-scale ranching, such as parts of Latin America). Furthermore, livestock provide the poor with fertilizer and draft power, along with the opportunity to exploit common grazing areas, build collateral savings, and diversify income.

At the low levels of calories consumed by the poor, lack of animal products, not over-consumption, should be the concern of policymakers.

Greater health risks of animal products are a concern.

The effects of the livestock revolution on the environment are potentially worrisome. Livestock contribute to environmental sustainability in mixed farming. But peri-urban concentrations can contribute to pollution. Policies have encouraged deforestation. In high-intensity systems, the large quantities of greenhouse gases and excess levels of nutrients produced by livestock pose dangers to the environment.

There are four main policy areas:

1. Small-scale producers have to be linked vertically with processors and marketers of perishable products. The poor find it difficult to gain access to productive assets such as credit and refrigeration facilities and to information such as knowledge about microbal infection prevention.

2. Policy can help facilitate the incorporation of smallholders into commercial production by remedying distortions that promote artificial economies and scale, such as subsidies to large-scale credit and grazing. Much greater attention should be given to livestock productivity and health issues, including post-harvest processing and marketing.

3. Regulatory mechanisms for dealing with the health and environmental problems arising from livestock production need to the developed. Technologies that address environmental and public health issues will not work unless regulatory enforcement backs them up.

4. Above all, small-scale producers need to the included in the response to this dynamic opportunity. Lack of policy action will not stop the Livestock Revolution, but it will ensure that the form it takes is less favorable for growth, poverty alleviation, and sustainability in developing countries.

SPARE SUB-SECTOR REVIEWS (2003)

Background: In early 2003, USAID established three expert panels to prepare "state of the art" papers on Sustainable Agriculture, Fisheries and Aquaculture, and Integrated Pest Management (IPM). The objective of each panel was to: 1) provide a strategic assessment of the global status of each of the three sub-sectors to establish a baseline level of information and 2) provide guidance to SPARE for directions for USAID agricultural/NRM programming.

Gutierrez, Andrew Paul, Marcos Kogan, and Ronald Stinner 2003 "Report of the External IPM Review Panel to SPARE."

Consultation Process: The IPM review was authored by three university scientists with additional input from Professor Herman Waibel (University of Hannover, Germany) who worked on the section on economic policy and who had also been involved in an earlier CGIAR review of IPM activities across the system. Paul Jepson (Oregon State University) contributed to the section on pesticide. The draft report was presented in May 2003 at a workshop sponsored by SPARE, attended by USAID staff, members of the US university community, and others. Recommendations from the final draft were summarized and reported in a review document presented to BIFAD in October 2003.[49]

OVERALL FINDINGS

The report states that USAID should focus on "regional pest problems where the impact on food security and hunger is large" and it stresses the importance of using "appropriate modern science and technology to solve pest problems" (8). It argues that IPM is a key component of sustainable agricultural systems and help to reduce crop and animal losses from pests, thereby serving to improve food security.

Official definitions of IPM used by USAID emphasizes pest control while minimizing hazards to humans, animals, plants and the environment; the definition used by the CGIAR emphasizes the use of ecological principles to promote crop and animal health and productivity, while minimizing the use of chemical controls (15). The report uses the following definition, which is broader and more multidisciplinary, and avoids reliance on "multiple tactics as the central criterion for IPM":

> [IPM is]…a decision support system for the selection and use of pest control tactics singly or harmoniously coordinated into a management strategy, based on cost/benefit analyses that take into account the interests of and impacts on producers, society, and the environment.[50]

While not reviewing the IPM CRSP in particular, the report supports the strengthening of an IPM CRSP activity as well as its linkage to other CRSPs and other activities in USAID's agriculture and NRM portfolio.

USAID's IPM activities are cited as contributing importantly to developing solutions to pest problems in developing countries, to educating scientists, farmers, and extension specialists, and to strengthening institutional capacity, particularly through its capacity building and its institutionalization of participatory IPM in developing country NARs.

Some gaps were identified in USAID's IPM program, notably:

- The lack of a "vision" for coordinating the various IPM activities within the Agency and between the Agency and other players in the field (7);
- The need to strengthen the research and outreach components of IPM by incorporating S&T innovations (7), and

[49] SPARE. "SPARE Recommendations to BIFAD: Sub-Sector Reviews of USAID Programs in Fisheries/Aquaculture, Integrated Pest Management, and Sustainable Agriculture" (October 2003).

[50] Cited on page 15 of the IPM report, taken from M. Kogan, "Integrated pest management: historical perspectives and contemporary developments," *Annual Review of Entomology 43: 243-277* (1998).

- Expertise on dealing with rapid onset invasive species problems (including as examples of bioterrorism) (34).

The report was forceful in its recommendation for more capacity building and student training in the sciences of IPM research.

SPECIFIC RESEARCH RECOMMENDATIONS

> …part of any vision for IPM program funding must be clear criteria, both political and scientific, for the development of programs in specific regions/countries involving specific commodities, and finally, specific pests and control approaches (43)….rather than selection of projects based on limited availability of personnel, or rationales developed *ex post facto* (44).

In general, IPM uses **host plant resistance (HPR), classical and natural biological control, habitat management control, chemical control, and biotechnology**, all of which are clear areas for scientific research. In addition, IPM use is affected by **agricultural policy**, another avenue for research. Among these, the report recommends **against** new work in HPR beyond "preliminary screening of germplasm materials for resistance of major arthropod pests and pathogens" (8) for the CRSPs because it requires such long-term horizons, but it supports some HPR work by IARCs (48), and it supports more work on the other topics listed above, such as:

- Classical and natural biological control of exotic pests in developing regions
- Cultural control and habitat management, particularly if linked to mainstream production research
- Development of biopesticides
- Biotechnology work in conjunction with sound ecosystem analyses and a strong policy environment

In addition, it recommends support of new research in GIS and dynamic modeling methodologies as well as development of methodologies for impact assessment. Research on social science issues and policy work were deemed particularly important in three areas: economically defined crop loss assessment, national crop protection policies and international trade issues, and impact assessment incorporating NRM (10). Expanding research on participatory research and extension (efforts in crop loss assessment were noted) and gender issues in IPM were also mentioned as important (68).

The report specifically notes two research efforts that had been recommended for CGIAR work that did not take place and advocates for USAID support to them:

- Whiteflies/Gemini viruses
- Stemborer/parasitic plants in maize/legume systems in Africa and the Middle East.

AQUACULTURE COLLABORATIVE RESEARCH PROGRAM

PD/A CRSP 2003 "Twentieth Annual Administrative Report, 1 August 2001 to 31 July 2002" Corvallis, OR: PD/A CRSP, Oregon State University. (http://pdacrsp.oregonstate.edu/pubs/admin/admin_20/20ar_toc.html)

PD/A CRSP 2003 "Executive Summary: Twenty-First Annual Administrative Report, 1 August 2002 to 31 July 2003" Corvallis, OR: PD/A CRSP, Oregon State University.

PD/A CRSP 2003 "Executive Summary: Twenty-Second Annual Administrative Report, 1 August 2003 to 31 July 2004" Corvallis, OR: PD/A CRSP, Oregon State University.

Aquacuture CRSP program (http://pdacrsp.oregonstate.edu)

Institutional Background: The PD/A CRSP started in September 1982. In 2004, it formally changed its name to the Aquaculture CRSP. It has experienced many changes among its collaborating partners and institutions over the years. Currently, it is administered through Oregon State University and is authorized until July 2006. In 2003-4, in addition to Oregon State University, actively participating US universities included Auburn University, Florida International University, North Carolina State University, Souther Illinois University at Carbondale, Texas Tech University, Ohio State University University of Michigan, University of Arizona, University of Arkansa at Pine Bluff, University of Georgia University of Hawaii, Hilo, University of Rhode Island, and the University of the Virgin Islands.

During the same program period, the CRSP had active research activities in 21 countries, including Bangladesh, Bolivia, Brazil, Cambodia, Columbia, Ecuador, El Salvador, Ghana, Guatemala, Honduras, Kenya, Laos, Mexico, Nicaragua, Panama, Peru, South Africa, Tanzania, Thailand, The Philippines, and Vietnam.

OVERVIEW

The overall goal of the Aquaculture CRSP is to conduct research that helps to identify and remove constraints to aquaculture development. As capture fisheries face increasing problems in the face of ecosystem degradation and overfishing, aquaculture can help to create economic growth while also improving food security and human nutrition.

SPECIFIC RESEARCH PRIORITIES

The focus of the CRSP's research program under its 1996 Continuation Plan was the identification of major constraints to aquaculture development. Initially, these included:

- Inefficient and inconsistent aquacultural productivity
- Negative environmental effects resulting form aquacultural operations
- A poor understanding of social and economic factors
- Insufficient human capacity development
- Poor or outdated information management
- Limited networking capacities

At the time, the CRSP's expected to present a new five-year grant proposal to USAID in 2003. Changes in the scheduling have the CRSP extended until July. During this time period it has been working under its Eleventh Work Plan, which included the following research themes:

- Environmental Impacts Analysis

- Sustainable Development and Food Security
- Production System Design and Integrataion
- Indigenous Species Development
- Water Quality and Availability
- Economic/Risk Assessment and Social Analysis
- Applied Technology and Extension Methodologies
- Seedstock Development and Availability
- Disease, Predation Prevention, and Food Safety
- Fish Nutrition and Feed Technology
- Aquaculture and Human Health Impacts

Among the many research activities carried out over the past few years (2002-2004) are included:

- Investigation of new methods of pond management to reduce a practice of draining the ponds to add lime and so improve water conservation and save producers money. Additional research showed that yearly additions of lime were unnecessary (in Thailand) and high soil quality could be maintained without it. Improved pond management practices in Kenya improved fish yields by over 400 percent.
- Use of activated charcoal to remove masculinizing hormones that pose environmental risks. The process is both environmentally friendly and reduces production costs.
- Investigation of polycutlure production systems, including research into catfish and lotus plants in Thailand, carp and catfish in Bangladesh, tilapia and perch in Vietnam (2003-4). Joint carp/tilapia production systems were studied in Nepal (in 2002-3), reducing the amount and cost of fish feed for the tilapia, and research was conducted in the Philippines on reducing the frequency of feeding to alternate days while sustaining yield levels.
- Artificial manipulation of fish sex to maximize yields.
- Employing GIS techniques to investigate watershed features and assessing their appropriateness for aquaculture development.

The CRSP is also involved in many training efforts as well as support students in degree programs. Extension activities have begun to expand their attention to women and other previously neglected groups of stakeholders, providing helpful information about improving fish pond management practices as well as information and participatory workshops on pond construction, fish handling, and stock management.

BASIS COLLABORATIVE RESEARCH PROGRAM

Broadening Access & Strengthening Input Systems Collaborative Research Support Program 2004 "Eighth Annual Report." Madison, WI: BASIS CRSP
http://www.basis.wisc.edu/

Institutional Background: The BASIS CRSP started in 1996. Its Management Entity is based at the University of Wisconsin, Madison. It is now in its second phase. Its current authorization period ends in September 2006.

Collaborative Process: From its start, the BASIS CRSP has used a highly collaborative process to establish research priorities and to develop its annual and longer-term work plans. Most of the first year of the project involved holding regional priority-setting workshops in the potential regional sites. The CRSP also committed to bringing representatives from host country institutions onto their advisory board and technical committee. Work plans are collaboratively developed between US and host country researchers.

OVERVIEW

The BASIS CRSP seeks to improve rural prosperity by making markets work for all, thus improving the quality of life for people in rural areas of the developing world. It targets global constraints by undertaking and disseminating collaborative, policy-oriented research. Since its inception, BASIS has focused on the interactions and inter-relationships of land, water, labor, and financial markets and the impacts of policy or policy reform in helping improve access to and efficiency of factor markets in multiple regions around the world. In its second phase, it has deepened its research on poverty traps and the operations of financial markets, credit, and microfinance institutions, and has begun to explore environmental markets.

The BASIS CRSP seeks to:

- Remove constraints to economic growth in order to raise the standard living of the poor.
- Increase food security by broadening the poor's access to key factors of production
- Reduce environmental destruction with policies and programs fostering sustainable land use
- Support US universities and researchers in collaboration with scientists and institutions abroad.

SPECIFIC RESEARCH TOPICS

A competition in 2004 led to the selection of several new research topics in new areas/countries for the CRSP:

- Pathways from Poverty: A multi-country study
- Regional Diversity in Pathways out of Rural Poverty in Brazil
- Microfinance in Theory and Practice: Field Experiments from South Africa
- Property Rights, Environmental Services and Poverty in Indonesia

Continuing projects include:

- Asset building for food security in Ethiopia
- Constraints to growth in Russian Agriculture
- Deepening of financial service through credit-reporting bureaus in Guatemala, El Salvador, and Peru
- Improving household well-being by improving access to credit in the Philippines

- Promoting equitable access to water resources in Malawi
- Reducing poverty in post-reform economies in Mexico and Peru
- Rural markets, natural capital, and dynamic poverty traps in East Africa
- Innovating institutions to help land reform beneficiaries in Central Asia.

BASIS has frequently included research on gender issues in many of its projects. It has received additional funding from the Office of Women in Development to support work on women's access to land titling.

It has also been recognized as employing innovative methodologies. During its first phase, research in El Salvador, Nicaragua and the Horn of Africa, used longitudinal surveys to track paths that individual households follow in and out of poverty.

It has also held or co-sponsored several policy-relevant workshops to which a wide range of participants have both contributed and attended, including one on problems of persistent poverty in Africa and another on rural finance.

BEAN/COWPEA

The Bean/Cowpea Collaborative Research Support Program 2003 "2003 Research and Training Highlights" East Lansing, MI: Michigan State University
http://www.isp.msu.edu/CRSP/

Institutional Background: The Bean/Cowpea CRSP was started in 1980. It is based at Michigan State University. Its current authorization runs through September 2007. Currently, the CRSP has 11 US partners.

Collaborative Process: In 2003, the first year of its new program, the Bean/Cowpea CRSP maintained research relationships with 24 host country institutions. It works on three Regional Projects in West Africa (WA), East and Southern Africa (ESA), and Latin America and the Caribbean Basin (LAC).

OVERVIEW

The goal of the CRSP is to increase the availability of beans and cowpeas (which in the US are mainly black-eyed peas), concentrating on all aspects of food handling from improved production technologies or strategies through food processing and the development of value-added products especially for urban markets. Through the strengthening of research networks, it seeks to address three pillar priorities:

- Applying cutting-edge science
- Developing and Strengthening bean and cowpea value-chains
- Building human resources through training a new generation of scientists.

SPECIFIC RESEARCH TOPICS

The following list contains titles of research activities described in more detail in the Annual Report.

- Strengthening the Cowpea "Value-Chain" in West Africa
- Determination of the Demand and Market Opportunities for Cowpea Grain and Processed Products in West Africa
- Development of Cowpea-Based Value-Added Foods with High Nutritive Health Values Preferred by Consumers and Food Processors
- Enhancing the Sustainability of and Intensifying Cowpea-Based Cropping Systems in Sudano
- Sahelian Zones in West Africa and in the U.S Development of Improved Cowpea Cultivars with Increased Yield Potential, Tolerant of Biotic and Abiotic Stresses, and Having Grain Quality Traits Preferred by Farmers and Consumers
- Assessment of the Nematode Incidence and Speciation in West African Soils, Identification of Genetic Resistance to Nematodes in Cowpea and the Development of Strategies to Control Nematodes in Cowpea-Based Cropping Systems
- Molecular Genetic Improvement of Cowpea for Growers and Consumers

GENERATING NEW KNOWLEDGE AND TECHNOLOGIES IN EAST AND SOUTHERN AFRICA

- Market Assessment of Bean and Cowpea Grain and Processed Value-Added Products, and Determination of both Constraints to and Potential for Growth of Markets in the ESA Region
- Enhancement of the Use of Quality Criteria for Crop Improvement Programs of Beans and Cowpeas in the ESA Region

- Development of Technologies to Facilitate the Introduction of Low-Cost, Value-Added Bean and Cowpea-Based Food Products Enhancement of Child Survival and Rehabilitation of Malnourished Children Through the Development of Inexpensive Bean/Sorghum/Maize Foods
- Improved Water Management for Intensified Bean Production in Malawi in the Dry Season, Taking into Account Labor and Capital Constraints of Women and Resource-Poor Farmers
- Edaphic Constraints to bean Production in Eastern Africa: The Selection of Bean Cultivars and Rhizobium having Tolerance to Low N and P, and Ability to Grow at Acid pH
- Development of Cost-Effective and Sustainable Seed Multiplication and Dissemination Systems for Improved Bean Cultivars that Meet the Needs of Limited-Resource Bean Farmers
- Develop Bean Cultivars for East and Southern Africa with Enhanced Resistance to Diseases and Insects
- The Use of Marker-Assisted Selection to Improve Selection Efficiency in Bean Breeding Programs
- Building on Latin America and Caribbean Project's Accomplishments
- Assessment of Constraints to Expanding Bean Supply in Central America
- Enhancement of Demand and Market Opportunities for Beans and Value-Added Products from Central America and the US
- Enhanced Bean Utilization in the US and Central America
- Increasing Knowledge on the Nutritional and Health Benefits of Beans and Cowpeas as Related to Reducing the Incidences of Cancers and Chronic Diseases
- Gender and Participatory Research in the Improvement of Bean Varieties (*Phaseolus vulgaris* L.) and Seed Production Systems in the Andean Highlands of Ecuador
- Genetic Improvement of Bean Adaptation to Low Fertility Soil
- Develop Improved Bean Cultivars for the Lowland Production Regions of Central America and the Caribbean
- Develop Sustainable Disease Management Strategies for Bean Rust and Web Blight
- Development of Improved Bean Cultivars for Highland Production Regions
- Identification and Deployment of Resistance Genes for Anthracnose, Rust and Drought in Beans for the Highlands using Modern Molecular Genetics Tools

CROSSCUTTING ACTIVITIES

- The Impact of Bean Research in Michigan

GLOBAL LIVESTOCK

Global Livestock CRSP [2003] "Global Livestock CRSP Annual Report 2003" Davis, CA: University of California, Davis (http://glcrsp.ucdavis.edu/)

Global Livestock CRSP 2004/5 "Global Livestock CRSP Annual Report 2004" DRAFT. Davis, CA: University of California, Davis.

Institutional Background: The Global Livestock CRSP was initiated in 1996 as a restructuring of the earlier Small Ruminant CRSP that began in 1978, the first of the CRSPs. It has always been managed through the University of California, Davis. In 2003, the program included 18 collaborating US universities or research institutions. The program is managed by a Program Director, responsible for program development, coordinating activities of the projects across and within regions, and oversight of program operations, supported by an Associate Director and program staff. In addition, an External Program Administrative Council, including US and international/regional representation, provides input on the overall program goals, recommends strategies for programmatic development and advises and concurs on the program budget. A Technical Committee provides intellectual exchange and input on programmatic planning for the CRSP to the Program Director and the Program Administrative Council. There is also a group of external technical experts who are available to assist with objective evaluations of program activities as needed.

Consultation Process: In 1995, in transition from the Small Ruminant CRSP to the Global Livestock CRSP, a comprehensive consultative process was initiated with priority setting workshops in the three regions. These meetings provided a forum for stakeholder input in the design of the new program's framework, and to present their views on the development issues they faced. Each workshop identified "problem models" followed by assessment teams, selected in an initial competition that developed projects addressing the top priorities within the regions. "To ensure grass roots input, over 20 regional workshops involving 35 countries were conducted during the assessment period. The teams submitted final proposals for a competition to be included in a proposal to USAID. The process was designed to be problem driven and produced result-oriented projects." Each year, annual workplans are developed collaboratively between US and host country researchers.

OVERVIEW

Under the umbrella goal of improving food security, the strategic goals of the GL CRSP include:

- Improve the interaction between livestock production and natural resource use and conservation, and more effectively integrate livestock production systems with the rational use of natural resources, such as wildlife and water.
- Decrease poverty and increase the security of people whose livelihoods depend on livestock by providing mechanisms to manage risk.
- Enhance the nutritional status - and decrease morbidity and mortality - of targeted populations, particularly children and women, through the increased availability and utilization of animal source products, thereby increasing human capacity.
- Strengthen the ability of institutions in developing countries to identify problems in livestock production and develop appropriate solutions.
- Provide support to decision makers in developing policies that will promote: a) livestock production, marketing, and trade; b) human nutrition and child physical and cognitive development; and c) natural resource conservation and management.

- Develop and strengthen communication systems (including but not limited to extension) among livestock producers, policy makers, businesses, researchers, and consumers that promote greater market participation, increase human and institutional capacity, and improve policy.

SPECIFIC RESEARCH PRIORITIES

The overall theme around which specific research activities orbit is one of risk management, addressed at different levels of operation, from the family and household to the landscape. It is a systems approach rather than a commodity approach. The following project descriptions are extracted from the draft 2004 Annual Report.

Current activities (including both established projects and some pilot grant activities) are directed towards:

- Closing the gap between human nutrition, health, and agriculture research through work on the role of animal source foods in children's cognitive performance and the development simple indicators of dietary diversity and ASF, and validate their performance in predicting nutrient adequacy. A planning grant was given to study the availability, accessibility, and utilization of ASF from the perspectives of caregivers and community workers and program managers of agriculture-, health- and nutrition-based organizations. Exploratory work is also being conducted in Nepal, and another comparative project is in place in Latin America and Africa.

- Adapting successful US technologies in forage and animal monitoring technology for use by pastoralist to improve knowledge about pasture conditions (the Gobi Forage Project in Mongolia and the Livestock Information Network and Knowledge Systems (LINKS) for Enhanced Pastoral Livelihoods in East Africa. By getting accurate and timely information on forage conditions to herder groups, they are able to make decisions about grazing to increase the nutritional benefit to their herds and ultimately to make better business decisions to enhance the profitability among an array of livestock enterprises.

- Better understanding of pastoralists and agro-pastoralists risk management decisions with regard to livestock production and marketing. Livestock market improvement offers the potential to reduce poverty in areas that are identified as the poorest in East Africa and in Central Asia (e.g., Improving Pastoral Risk Management on East African Rangelands (PARIMA) and Livestock Marketing in Kenya and Ethiopia (LITEK), and Improving Wool Production and Marketing Through Wool Pools in Kazakhstan and Kyrgyzstan (WOOL)).

- Improving long-term sustainability of rural watersheds in Kenya and East Africa through a multidisciplinary research effort focusing on biophysical and human-related factors governing watershed processes (Sustainable Management of Watersheds: The River Njoro, Kenya (SUMAWA))

- Improving the quality of life for small landholders through land use and livestock management that is sustainable at the family and community level and sustainable for the environment at the watershed scale. The project work is organized around four principal objectives: 1) Identify the potentials and limitations for community sustainable management of natural resources and livestock, and improved quality of life. 2) Evaluate current practices of livestock and natural resource management and experiment with alternatives. 3) Generate a participatory process for planning, implementing, and monitoring current and alternative practices. 4) Establish a long-term, on-going, community planning process for natural resource and livestock management (Community Planning for Sustainable Livestock-based Forested Ecosystems in Latin America).

- Collaborative research on national park management (between Yellowstone National Park in the US and Serengeti National Park in Tanzania).

INTEGRATED PEST MANAGEMENT

Integrated Pest Management Collaborative Research Support Program (IPM CRSP) 2004 IPM CRSP Annual Highlights Year 11, 2003-2004. Blacksburg, VA: Office of International Research, Education, and Development, Virginia Tech.
http://www.ag.vt.edu/ipmcrsp/annrepts/highlights/highlights%20year%2011.pdf

USAID 2004 Request for Applications (RFA) Number (M/OP/EGAT/PEP04-1501 Integrated Pest Management (IPM), Collaborative Research Support Program (CRSP), Section C: Program Description. Washington, DC: USAID.

Institutional Background. The IPM CRSP, one of nine USAID-funded CRSPs, is headquartered at Virginia Tech. The 2003-2004 year was the final year of the second phase of its program. In 2004 it began a new phase under a cooperative agreement that is authorized until September 2009. The program consists of scientists in a consortium of US universities who work in partnership with researchers in international and national agricultural centers and well as in universities overseas.

Collaborative Process. The CRSP was working in ten countries with 21 different host country institutions and had research relationships with six international centers. Other partners included four private sector institutions and five NGOs. Work plans are developed in conjunction with host country researchers, and in some cases, with input from local farmers.

OVERVIEW

The overall program of the IPM CRSP is, by developing improved IPM technologies and by changing institutions, intended to reduce agricultural losses due to pests, damage to national ecosystems, and pollution and contamination of food and water supplies. By so doing, the program will help to increase farmer incomes, reduce pesticide use and residues on products, improve IPM research and education capabilities, improve abilities to monitor pests, and increase women's involvement in IPM (i). USAID's RFP for a new IPM CRSP states: "IPM practices are the basis for protecting gain made through crop improvement programs while protecting the environment, human health, conserving biodiversity, and other natural resources" (2004 26).

There are five specific objectives of the IPM CRSP which are addressed differently in each regional/country program:

- Identify and describe the technical factors affecting pest management
- Identify and describe the social, economic, political and institutional factors affecting pest management
- Work with participating groups to design, test, and evaluate appropriate participatory IPM strategies
- Work with participating groups to promote training and information exchange on participatory IPM
- Work with participating groups to foster policy and institutional changes.

In 2003-2004, the CRSP was operating in West Africa (Mali), East Africa (Uganda), South America (Ecuador), Central America (Guatemala and Honduras), the Caribbean (Jamaica), Southeast Asia (Philippines), South Asia (Bangladesh), and in Eastern Europe (Albania).

SPECIFIC RESEARCH ACTIVITIES

The main document reports on research completed or in progress, rather than research recommendations.[51]

[51] It is not possible to provide detail on the current research programs. Please refer to the Website for more information.

There are eight regional programs in West Africa (Mali), East Africa (Uganda), South America (Ecuador), Central America (Guatemala and Honduras), the Caribbean (Jamaica), Southeast Asia (Philippines), South Asia (Bangladesh), and in Eastern Europe (Albania). All work with local institutions as partners in CRSP research. The research work broadly encompasses collaboration, technology transfer, research on IPM constraints, and networking, including specific research on (among other things):

- work on viral diseases and varietal evaluations of tomatoes; weed control strategies in horticultural production in West Africa; viruses, insects, and parasitic diseases on cowpea, groundnuts, maize, sorghum, tomato, peppers, and coffee in East Africa; snow peas and broccoli in Central America;
- developing alternatives to chemical pesticide use through biological control with groundnuts and cowpea in East Africa and for thrips on snow peas and vine decline of melons in Central America
- testing packages to address pest problems in peri-urban horticultural crops and rural areas in most regions (export green beans, which are plagued by pod borers, thrips, whitefly, and soil-borne diseases; local tomatoes, which are affected by whitefly-transmitted viruses and other viruses; eggplant, cucurbit crops, cabbage, onions, and hibiscus)
- testing of biological control of insect pests and managing *striga* parasitic weed on millet and sorghum. Some of the work to develop packages involves using biotechnology techniques as well as other conventional methods.
- disseminating farmer-tested IPM packages; holding farmer field schools (all regions)
- pesticide residue analysis to improve methods for reducing pesticide use
- application of biotechnological techniques on quality protein maize and coffee wilt in Uganda; tissue culture on papaya to address ringspot polyvirus.
- market research on cowpeas in East Africa; socio-economic studies
- bioclimatic modeling in Central America
- research on post-harvest technologies of maize to improve quality
- improving production practices among non-traditional agricultural exporters in South and Central America and the Caribbean and expanding to new market crops (e.g., naranjilla) as well as staple crops (e.g., plantain and potatoes) and in agroforestry systems. "Control of pest in potatoes is a top priority for North America as well as in South America" (27).

SPECIFIC RESEARCH RECOMMENDATIONS

USAID's RFP (2004) for the new IPM CRSP identified the following possible areas for investigation or tools to employ:

- Ecologically-based IPM (including breeding for host plant resistance and integrating naturally resistant cultivars into cropping system, building expertise in classical and natural biological control, micro and macro habitat management control to encourage natural enemies of pests).
- Government policy and regulations (e.g., on pesticide use and its collateral health and environmental effects, on genetically modified crops, and one required ecosystem analyses)
- Gender (as relevant to farmers, extension agents, and researchers)
- Cultural constraints (research on making IPM strategies transferable across communities)

- Integration across other IPM activities, including those in the USAID, CGIAR/IARC, and National IPM Program portfolios (the RFP lists a long set of very specific options, page 30).
- Use of appropriate new technologies, including e.g., biotechnology, GIS, and agrochemicals.
- Training and education for researchers, extension agents, and farmers; participatory research, and institutional strengthening.
- Assessments of the relative effectiveness of various methods.

PEANUT

Peanut Collaborative Research Support Program 2004 Annual Report Watkinsville, GA: Peanut CRSP

http://www.griffin.peachnet.edu/pnutcrsp.html

Institutional Background. The Peanut CRSP was started in 1982. It is based at the University of Georgia. Its current authorization runs through July 2006. The CRSP is composed of the following US universities including Alabama A&M University, Auburn University, University of Connecticut, University of Florida, University of Georgia, Purdue University, North Carolina A&T State University, North Carolina State University, Virginia Polytechnic Institute and State University and Texas A&M University, as well as it many overseas institutions.

Collaborative Process. The Peanut CRSP works with institutions in 16 nations around the world, in West and Southern Africa, Latin America and the Caribbean, Asia, and Eastern Europe.

OVERVIEW

The Goals of the Peanut Collaborative Research Support Program (CRSP) are to enhance research capability in developing countries and the United States and to focus this capability on the alleviation of major researchable constraints that limit sustainable peanut production and food delivery through an environmentally sound system.

Peanut is the most important crop for development in many areas of the developing world, particularly Sub-Saharan Africa. This crop provides an important source of purchasing power to its small-scale farmers, many of whom are women. Because local markets exist for peanuts, they provide an essential opportunity for small-scale subsistence farmers to purchase inputs, such as fertilizers, needed to make farming sustainable. About 50 percent of peanut production is traded within the producing country and used for oil production. A further fraction is traded and often forms the basis of village-level value-adding industries. While peanuts often are vital as a high energy, high protein food for many at or below the poverty line, the readily saleable products which the crop provides are a source of purchasing power for producers and processors, many of whom are women. Cash crops, such as peanuts, play a critical role in financing inputs of items such as fertilizer (necessary for sustainable productivity at the system level) and are associated with the growth of economic activity and better standards of human well-being. Peanuts also contribute up to 60 kg ha-1 nitrogen to the soil, diminishing the need for a fertilizer essential to sustained yields of the subsistence cereals that do not readily enter trade. The alternative is subsidized, chemical nitrogen fertilizer. Therefore, peanuts are particularly important in the development of employment, trade, purchasing power and for the sustainability of agriculture-dependent economies in the developing world.

SPECIFIC RESEARCH TOPICS

In its current phase, the Peanut CRSP started working on new constraint and geographic areas, focusing on aflatoxins, production efficiency, socioeconomic forces and utilization/postharvest issues. Currently, it has five "research thrusts." Each is noted below, followed by a listing of research topics. The listing is drawn from the Website (May 2005):

FOOD SAFETY

- Sustainable Enterosorbent Strategies for the Protection of African Populations from Aflatoxin
- Genetic Approaches to Eliminate Aflatoxin Contamination of Peanuts
- Systems Research to Assess Risk of Preharvest Aflatoxin Contamination and to Develop Technologies to Reduce Aflatoxin Contamination of Peanut
- Effects of Peanut Consumption on Hunger, Ingestive Behavior, Energy Expenditure, and Coronary Heart Disease Risk

- Extrusion Cooking of Peanut Meal in the Presences of Lysine to Deactivate Aflatoxin and Improve Nutritional Quality
- Aflatoxin Impacts on Immune System

PRODUCTION

- Biochemical and Molecular Responses of Peanut to Drought Stress and their role in Aflatoxin Contamination
- Valencia Peanut Breeding for High Yield, Early Maturity, and Resistance to Fungal Diseases, and Good Quality
- Development of Sustainable Peanut Production Technologies for Amerindian Villages in …Guyana
- Control Strategies for Peanut Viruses
- Improved Production Efficiency Through Standardized, Integrated, and Enhanced Research and Technology
- Breeding Peanut for Better Productivity and Quality
- Development and Use of Multiple-Pest Resistance to Improve Production Efficiency of Peanut
- Simulation of Peanut Cropping Systems to Improve Production Efficiency and Enhance NRM

SOCIO-ECONOMIC

- Gender issues in Aflatoxin Incidence and Control in Groundnut Production Systems of West Africa
- Socioeconomic Impacts of Alternative Peanut Production Marketing Systems in Senegal
- Production Efficiency and Market Development of Peanuts and Peanut Products for Haiti, Dominican Republic, and Jamaica
- Analysis of Response of Peanut Production in French West Africa
- Adoption/Diffusion Processes, Persistence, and Socioeconomic Impacts of New Inputs and Peanut Varieties

UTILIZATION

- Use of chemoprotection in product development to improve safety and production of peanut products in Ghana, West Africa
- Development of Spicy Meat analogs and technology transfer of value-added products from peanuts
- Development and transfer of peanut processing technologies in Bulgaria
- Development of peanut post-harvest handling and processing technologies for the food industry

INFORMATION AND TECHNOLOGY TRANSFER

- Seed for Disaster Recovery and development in groundnut producing countries
- International collaboration
- Long and short term training for host country scientists
- Training for SE Asia region

- The world geography of the peanut

GRAIN SORGHUM/PEARL MILLET

INTSORMIL 2004 "INTSORMIL Annual Report" Grain Sorghum/Pearl Millet Collaborative Research Support Program (CRSP). Intsormil Publication 04-03. Lincoln, NE: University of Nebraska. (http://intsormil.org/icannrep.htm)

Institutional Background: The Grain Sorghum/Pearl Millet (INTSORMIL) CRSP was started in 1979, the first of the CRSP programs. It has always been managed by a Management Entity at the University of Nebraska, though the partnering US universities and overseas institutions have changed over its lifetime. In 2004, its seven US partners included (Kansas State University, Mississippi State University, University of Nebraska – Lincoln, Purdue University, Texas A&M University, USDA-ARS, Tifton, Georgia, and West Texas A&M University) and overseas research institutions in nineteen countries across three regions of Africa (west, east, and southern) and in Central America. The CRSP maintains a Board of Directors (BOD) to provide management and policy guidance. A Technical Committee (TC), External Evaluation Panel, and USAID personnel provide added operational advice.

Collaborative Process: "The INTSORMIL mission is to use collaborative research as a mechanism to develop human and institutional research capabilities to overcome constraints to sorghum and millet production and utilization for the mutual benefit of the US and Less Developed Countries (LDCs)" (2004: ix). Representatives from both the US and participating overseas institutions serve on the BOD and TC. The project has provided education and training to many (49 students from 19 countries in 2003-4 in degree programs and 29 in non-degree programs; over 1000 scientists through the life of the project thus far), approximately one-third from the US and two-thirds from developing countries.

Work plans and programs are generally developed through regional planning workshops attended by US and host country researchers. The CRSP works with NARS to strengthen national and regional scientific networks. The African regional programs note a decline in the number of national sorghum and pearl millet scientists (2004: xiii).

OVERVIEW

Nearly all of the 3 billion increases in global population expected by 2025 will be in developing countries where water will be scarce. To meet increasing demand for food in those countries, there is an increasing demand for more efficient production and new ways of utilizing drought-tolerant crops such as sorghum and millet. INTSORMIL's goal is to improve human and animal nutrition through research on production and utilization of sorghum and millet.

The annual report provides a snapshot of a current year's activity in the CRSP. In 2003-4, the CRSP was noted to be contributing to "the transformation of sorghum and pearl millet from subsistence crops to value-added cash crops." Both crops continue to be important staple crops particularly in "moisture-stressed regions of the world" (2004: ix). In addition to its significant education, training, and capacity-building achievements in 2003-4, the CRSP's research activities are helping to improve the drought tolerance and food quality and digestibility of the sorghum and millet crops as well as to develop new products from them. New markets are also emerging for pearl millet, from its use as poultry feed to floral arrangements in the US, and as higher-value food products overseas.

SPECIFIC RESEARCH PRIORITIES

The program works to address specific productivity constraints for sorghum and millet (productivity, yield stability, and pest management). Some of the research tasks to improve the production, processing, and utilization of these crops currently include activities to:

- Conserve biodiversity (e.g., sorghum and millet germplasm enhancement and conservation)
- Conserve natural resources (e.g., improving sustainable production systems, maintaining natural control of arthropod pests, developing cultivars with improved nutrient and water use efficiencies)

- Biotechnology research
- Promote demand-driven processes (e.g., economic analyses on the value chain, prices, and the impact and diffusion of new technologies).

Research is being conducted under three technical thrusts that is described in detail in the summaries and descriptions of individual research workplans and achievements:

- Germplasm Enhancement and Conservation
- Sustainable Production Systems
- Sustainable Plant Protection Systems
- Utilization and Marketing
- Biotechnology

Exemplary topics of some of the specific research efforts within the regional programs include:

- West Africa:
  - Introgressing *striga* resistance into a local variety, El Mota
  - Continued development of a midge resistant sorghum line
  - Work with downy millet resistance
  - Using new hybrids/varieties of millets in high quality foods
  - Developing a commercially viable millet couscous
  - Improving production for a sorghum used in beer making
  - Research on fertilizer and water input for improved yields
  - Germplasm exchange
  - Millet breeding and millet pathology
- Horn of Africa:
  - *Striga* management and the testing of new technology packages of resistant cultivars, fertilizers, and water management with farmers, and some testing of wild strains.
  - Support seed production and delivery systems
  - Research on grain markets
- Southern Africa:
  - Breeding of hybrid parents for sorghum and millet
  - Control of sorghum ergot
  - Food quality research
  - Plant pathology

  - Grain quality
  - Entomology
- Central America:
  - Development of new varieties (increased yield, increased nitrogen use, improved photoperiod sensivity)
  - Development of forage and grain hybrids
  - Greater efficiency in milling
  - IPM techniques for army worm, sorghum midge, and other priority disease problems.

SOIL MANAGEMENT

Soil Management CRSP 2003 "Project Year 6, Annual Progress Report" University of Hawaii. http://tpss.hawaii.edu/sm-crsp/pubs/pdf/annrpt_py6.pdf

Institutional Background. The Soil Management CRSP is based at the University of Hawaii Manoa. It started in 1981 at the University of North Carolina and moved to Hawaii in 1997. In 2002-3 it was working with the following US partners: Cornell University, Montana State University, North Carolina State University, and University of Florida.

Collaborative Process. The CRSP has recently or is currently working with the researchers at instutitions in Africa, Latin America, and Asia, and has relationships with numerous of IARCs.

OVERVIEW

The global plan is directed toward attaining the SM-CRSP's goal of achieving food security in regions of the world where hunger and poverty are highest, and enabling its clients to do so without compromising the sustainability of agroenvironments. The plan gives priority to the food insecure regions of Africa, Asia, and Latin America where most of the 700 million food insecure people live. The SM-CRSP will contribute to the on-going international effort to reduce food insecurity by focusing on the following objectives:

1. Enable developing country institutions to apply information technology and knowledge-based tools to increase agricultural productivity.
2. Enable developing country institutions to scale-up technology adoption by farmers from local to regional scales.
3. Strengthen human and institutional capacity to combat poverty, land degradation and food insecurity.

SPECIFIC RESEARCH TOPICS

The CRSP carries out research within five topic areas.

NUTRIENT MANAGEMENT SUPPORT SYSTEM

- Testing, Comparing and Adapting The Nutrient Management Support System (NuMaSS) by users in different geographical regions of South East and Asia West Africa
- Adoption of the Nutrient Management Support System Software Throughout Latin America

TRADE-OFF ANALYSIS

- Trade-Off Analysis Project Phase 2: Scaling Up and Technology Transfer to Address Poverty, Food Security and Sustainability of the Agro-Environment

RICE-WHEAT SYSTEMS

- Enhancing Technology Adoption For the Rice-Wheat Cropping System Of the Indo-Gangetic Plains

CARBON SEQUESTRATION

- Measuring and Assessing Soil Carbon Sequestration by Agricultural Systems in Developing Countries

BIOTECHNOLOGY

- Assessing the Effects of Bt Crops and Insecticides On Arbuscular Mycorrhizal Fungi and Plant Residue Carbon Turnover and Fate in Soil
- Genetic Characterization of Adaptive Root Traits In the Common Bean

The CRSP also provides field support to USAID missions.

SANREM

Sustainable Agriculture & Natural Resource Management Collaborative Research Support Program (SANREM)
Current phase: http://www.oired.vt.edu/sanremcrsp
First two phases: http://www.sanrem.uga.edu/

Institutional Background. The new SANREM activity was started at Virginia Tech in 2004. The first two phases of the project were headquartered at the University of Georgia, from 1992.

OVERVIEW

The new SANREM CRSP has recently awarded its first eighteen planning awards for new activities involving eleven lead UN universities. The Planning Awards will involve activities in 27 different developing countries and will culminate in the development of Long-Term Research Applications. Up to six Long-Term Research Applications will be funded for a period of up to four years, with applications due in September 2005.

The first phases of SANREM at the University of Georgia had the objective of supporting Natural Resource Management (NRM) decision-makers at multiple levels by providing access to appropriate data, information, tools and methods of analysis, and by enhancing capacity to make better decisions and thereby improve the sustainability of natural resources. Its holistic approach is based on four cornerstones: 1) Landscape/Lifescape interactions; 2) Participatory methodologies; 3) Interdisciplinary teamwork 4) Institutional partnerships.

SPECIFIC RESEARCH TOPICS

The new planning awards address the following topics:

GLOBAL

- Decentralization Reforms and Property Rights: Potentials and Puzzles for Forest Sustainability and Livelihoods
- Expanding Local Capacities To Deliver Agricultural Production, Biodiversity Conservation And Local Livelihood Benefits In Ecoagricultural Landscapes: A Hybrid Institutional Approach
- Integrated Watershed Management to Support Community-Based Responses to Increasing Water Scarcity

AFRICA

- Large Scale Linkages Between Agriculture and Wildlife Health in the Rungwa-Ruaha Ecosystem, Tanzania
- Restoration Of Biodiversity And Economic Values To Degraded Rainforest And Agricultural Landscapes in Southeastern Madagascar
- Agricultural Transitions in West Africa: Impacts on Agropastoral Livelihoods, Livestock Mobility and the Environment
- Promoting Sustainable Agriculture and Natural Resource Management for Livelihood Security
- Multi-Disciplinary Research to Optimize a Market-Driven Approach to Food Security, Improved Rural Livelihoods, and Biodiversity Conservation in the Luangwa Valley Watershed Region in Zambia
- Promoting Sustainable Development in West Africa through Creation and Dissemination of Knowledge to Improve Cotton-Based Agricultural Systems

LATIN AMERICA AND THE CARIBBEAN

- Natural Resource Management for Small-scale Agriculture: Sloped Areas of Latin America and the Caribbean
- Rural Poverty, Watershed Conservation, and Public Policy in Latin America
- Cover Crops in Natural Resources Improvement and Tree Crops Sustainability under Tropical Agro-forestry Systems in South America
- Caribbean Food Systems Vulnerability to Global Environmental Change

ASIA AND NEAR EAST

- Agroforestry and Sustainable Vegetable Production in Southeast Asian Watersheds
- Dynamics of farm-forest linkages in the context of changing land-use policies in South and Southeast Asia
- Assessing the Linkages between Community Conservation & Governance in Nepal's Forest User Groups

EURASIA

- Healthy Landscapes: Developing a Framework and Indicators for Sustainability and Management
- The Livestock, Wildlife, and Human Health Interface in Mongolia