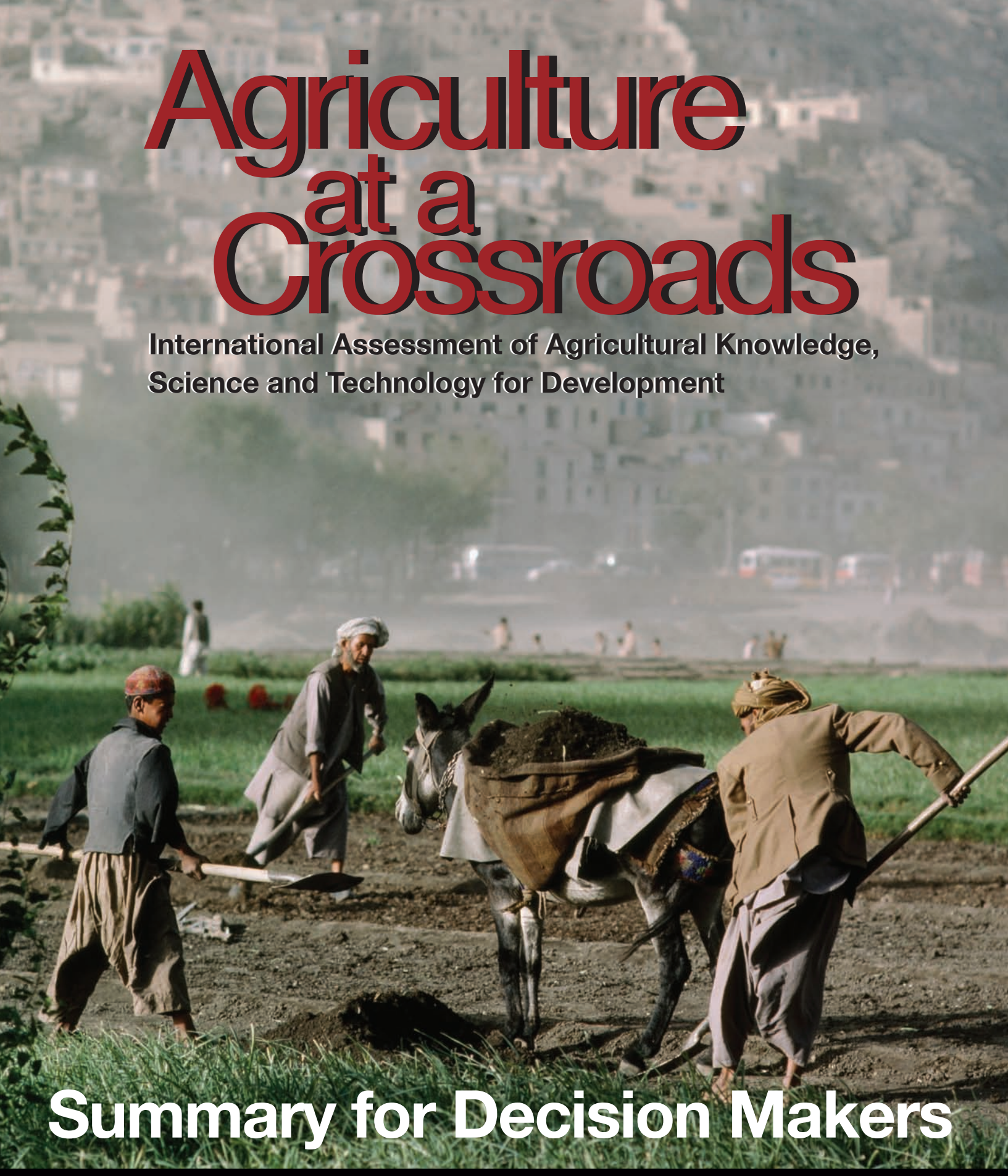
Agriculture at a Crossroads

International Assessment of Agricultural Knowledge, Science and Technology for Development



Summary for Decision Makers

IAASTD

Central & West Asia & North Africa

IAASTD

International Assessment of Agricultural Knowledge, Science and Technology for Development

Summary for Decision Makers of the Central and West Asia and North Africa (CWANA) Report


IAASTD
International Assessment of Agricultural Knowledge, Science and Technology for Development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IAASTD

International Assessment of Agricultural Knowledge, Science and Technology for Development

Summary for Decision Makers of the Central and West Asia and North Africa (CWANA) Report

This summary was approved in detail by CWANA governments attending the IAASTD Intergovernmental Plenary in Johannesburg, South Africa (7-11 April 2008).

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Contents

Foreword

The objective of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) was to assess the impacts of past, present and future agricultural knowledge, science and technology on the:

- reduction of hunger and poverty,
- improvement of rural livelihoods and human health, and
- equitable, socially, environmentally and economically sustainable development.

The IAASTD was initiated in 2002 by the World Bank and the Food and Agriculture Organization of the United Nations (FAO) as a global consultative process to determine whether an international assessment of agricultural knowledge, science and technology was needed. Mr. Klaus Töepfer, Executive Director of the United Nations Environment Programme (UNEP) opened the first Intergovernmental Plenary (30 August-3 September 2004) in Nairobi, Kenya, during which participants initiated a detailed scoping, preparation, drafting and peer review process.

The outputs from this assessment are a Global and five Sub-Global reports; a Global and five Sub-Global Summaries for Decision Makers; and a cross-cutting Synthesis Report with an Executive Summary. The Summaries for Decision Makers and the Synthesis Report specifically provide options for action to governments, international agencies, academia, research organizations and other decision makers around the world.

The reports draw on the work of hundreds of experts from all regions of the world who have participated in the preparation and peer review process. As has been customary in many such global assessments, success depended first and foremost on the dedication, enthusiasm and cooperation of these experts in many different but related disciplines. It is the synergy of these interrelated disciplines that permitted IAASTD to create a unique, interdisciplinary regional and global process.

We take this opportunity to express our deep gratitude to the authors and reviewers of all of the reports—their dedication and tireless efforts made the process a success. We thank the Steering Committee for distilling the outputs of the consultative process into recommendations to the Plenary, the IAASTD Bureau for their advisory role during the assessment and the work of those in the extended Secretariat. We would specifically like to thank the cosponsoring organizations of the Global Environment Facility (GEF) and the World Bank for their financial contributions as well as the FAO, UNEP, and the United Nations Educational, Scientific and Cultural Organization (UNESCO) for their continued support of this process through allocation of staff resources.

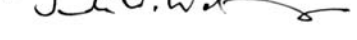
We acknowledge with gratitude the governments and organizations that contributed to the Multidonor Trust Fund (Australia, Canada, the European Commission, France, Ireland, Sweden, Switzerland, and the United Kingdom) and the United States Trust Fund. We also thank the governments who provided support to Bureau members, authors and reviewers in other ways. In addition, Finland provided direct support to the Secretariat. The IAASTD was especially successful in engaging a large number of experts from developing countries and countries with economies in transition in its work; the Trust Funds enabled financial assistance for their travel to the IAASTD meetings.

We would also like to make special mention of the Regional Organizations who hosted the regional coordinators and staff and provided assistance in management and time to ensure success of this enterprise: the African Center for Technology Studies (ACTS) in Kenya, the Inter-American Institute for Cooperation on Agriculture (IICA) in Costa Rica, the International Center for Agricultural Research in the Dry Areas (ICARDA) in Syria, and the WorldFish Center in Malaysia.

The final Intergovernmental Plenary in Johannesburg, South Africa was opened on 7 April 2008 by Achim Steiner, Executive Director of UNEP. This Plenary saw the acceptance of the Reports and the approval of the Summaries for Decision Makers and the Executive Summary of the Synthesis Report by an overwhelming majority of governments.

Signed:

Co-chairs
Hans H. Herren
Judi Wakhungu



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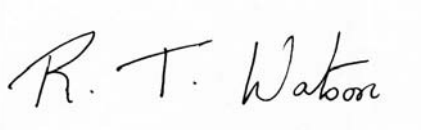

Central and West Asia and North Africa (CWANA) Summary for Decision Makers

Writing Team: Alia Gana (Tunisia), Mustapha Guellouz Kawther Latiri (Tunisia), Abid Suleri (Pakistan), Rym ben Zid (Tunisia)

Statement by Governments

All countries present at the final intergovernmental plenary session held in Johannesburg, South Africa in April 2008 welcome the work of the IAASTD and the uniqueness of this independent multistakeholder and multidisciplinary process, and the scale of the challenge of covering a broad range of complex issues. The Governments present recognize that the Global and Sub-Global Reports are the conclusions of studies by a wide range of scientific authors, experts and development specialists and while presenting an overall consensus on the importance of agricultural knowledge, science and technology for development also provide a diversity of views on some issues.

All countries see these Reports as a valuable and important contribution to our understanding on agricultural knowledge, science and technology for development recognizing the need to further deepen our understanding of the challenges ahead. This Assessment is a constructive initiative and important contribution that all governments need to take forward to ensure that agricultural knowledge, science and technology fulfills its potential to meet the development and sustainability goals of the reduction of hunger and poverty, the improvement of rural livelihoods and human health, and facilitating equitable, socially, environmentally and economically sustainable development.

In accordance with the above statement, the following governments approve the Central and West Asia and North Africa (CWANA) Sub-Global Summary for Decision Makers:

Azerbaijan, Bahrain, Iran, Kyrgyzstan, Lebanon, Libyan Arab Jamahiriya, Pakistan, Saudi Arabia, Tunisia, Turkey (10 countries).

Background

In August 2002, the World Bank and the Food and Agriculture Organization (FAO) of the United Nations initiated a global consultative process to determine whether an international assessment of agricultural knowledge, science and technology (AKST) was needed. This was stimulated by discussions at the World Bank with the private sector and nongovernmental organizations (NGOs) on the state of scientific understanding of biotechnology and more specifically transgenics. During 2003, eleven consultations were held, overseen by an international multistakeholder steering committee and involving over 800 participants from all relevant stakeholder groups, e.g., governments, the private sector and civil society. Based on these consultations the steering committee recommended to an Intergovernmental Plenary meeting in Nairobi in September 2004 that an international assessment of the role of AKST in reducing hunger and poverty, improving rural livelihoods and facilitating environmentally, socially and economically sustainable development was needed. The concept of an International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) was endorsed as a multi-thematic, multi-spatial, multi-temporal intergovernmental process with a multistakeholder Bureau cosponsored by the Food and Agriculture Organization of the United Nations (FAO), the Global Environment Facility (GEF), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Bank and World Health Organization (WHO).

The IAASTD's governance structure is a unique hybrid of the Intergovernmental Panel on Climate Change (IPCC) and the nongovernmental Millennium Ecosystem Assessment (MA). The stakeholder composition of the Bureau was agreed at the Intergovernmental Plenary meeting in Nairobi; it is geographically balanced and multistakeholder with 30 government and 30 civil society representatives (NGOs, producer and consumer groups, private sector entities and international organizations) in order to ensure ownership of the process and findings by a range of stakeholders.

About 400 of the world's experts were selected by the Bureau, following nominations by stakeholder groups, to prepare the IAASTD Report (comprised of a Global and five Sub-Global assessments). These experts worked in their own capacity and did not represent any particular stakeholder group. Additional individuals, organizations and governments were involved in the peer review process.

The IAASTD development and sustainability goals were endorsed at the first Intergovernmental Plenary and are consistent with a subset of the UN Millennium Development Goals (MDGs): the reduction of hunger and poverty, the improvement of rural livelihoods and human health, and facilitating equitable, socially, environmentally and economically sustainable development. Realizing these goals requires acknowledging the multifunctionality of agriculture: the challenge is to simultaneously meet development and sustainability goals while increasing agricultural production.

Meeting these goals has to be placed in the context of a rapidly changing world of urbanization, growing inequities, human migration, globalization, changing dietary preferences, climate change, environmental degradation, a trend toward biofuels and an increasing population. These conditions are affecting local and global food security and putting pressure on productive capacity and ecosystems. Hence there are unprecedented challenges ahead in providing food within a global trading system where there are other competing uses of agricultural and other natural resources. AKST alone cannot solve these problems, which are caused by complex political and social dynamics; but it can make a major contribution to meeting development and sustainability goals. Never before has it been more important for the world to generate and use AKST.

Given the focus on hunger, poverty and livelihoods, the IAASTD pays special attention to the current situation, issues and potential opportunities to redirect the current AKST system to improve the situation for poor rural people, especially small-scale farmers, rural laborers and others with limited resources. It addresses issues critical to formulating policy and provides information for decision makers confronting conflicting views on contentious issues such as the environmental consequences of productivity increases, environmental and human health impacts of transgenic crops, the consequences of bioenergy development on the environment and on the long-term availability and price of food, and the implications of climate change on agricultural production. The Bureau agreed that the scope of the assessment needed to go beyond the narrow confines of science and technology (S&T) and should encompass other types of relevant knowledge (e.g., knowledge held by agricultural producers, consumers and end users) and that it should also assess the role of institutions, organizations, governance, markets and trade.

The IAASTD is a multidisciplinary and multistakeholder enterprise requiring the use and integration of information,

tools and models from different knowledge paradigms including local and traditional knowledge. The IAASTD does not advocate specific policies or practices; it assesses the major issues facing AKST and points towards a range of AKST options for action that meet development and sustainability goals. It is policy relevant, but not policy prescriptive. It integrates scientific information on a range of topics that are critically interlinked, but often addressed independently, i.e., agriculture, poverty, hunger, human health, natural resources, environment, development and innovation. It will enable decision makers to bring a richer base of knowledge to bear on policy and management decisions on issues previously viewed in isolation. Knowledge gained from historical analysis (typically the past 50 years) and an analysis of some future development alternatives to 2050 form the basis for assessing options for action on science and technology, capacity development, institutions and policies, and investments.

The IAASTD was conducted according to an open, transparent, representative and legitimate process; is evidence-based; presents options rather than recommendations; assesses different local, regional and global perspectives; presents different views, acknowledging that there can be more than one interpretation of the same evidence based on different worldviews; and identifies the key scientific uncertainties and areas on which research could be focused to advance development and sustainability goals.

The IAASTD is composed of a Global assessment and five Sub-Global assessments: Central and West Asia and North Africa – CWANA; East and South Asia and the Pacific – ESAP; Latin America and the Caribbean – LAC; North America and Europe – NAE; Sub-Saharan Africa – SSA. It (1) assesses the generation, access, dissemination and use of public and private sector AKST in relation to the goals, using local, traditional and formal knowledge; (2) analyzes existing and emerging technologies, practices, policies and institutions and their impact on the goals; (3) provides information for decision makers in different civil society, private and public organizations on options for improving policies, practices, institutional and organizational arrangements to enable AKST to meet the goals; (4) brings together a range of stakeholders (consumers, governments, international agencies and research organizations, NGOs, private sector, producers, the scientific community) involved in the agricultural sector and rural development to share their experiences, views, understanding and vision for the future; and (5) identifies options for future public and private investments in AKST. In addition, the IAASTD will enhance local and regional capacity to design, implement and utilize similar assessments.

In this assessment agriculture is used to include production of food, feed, fuel, fiber and other products and to include all sectors from production of inputs (e.g., seeds and fertilizer) to consumption of products. However, as in all assessments, some topics were covered less extensively than others (e.g., livestock, forestry, fisheries and agricultural engineering), largely due to the expertise of the selected authors.

The IAASTD draft Report was subjected to two rounds of peer review by governments, organizations and individuals. These drafts were placed on an open access Web site and open to comments by anyone. The authors revised the drafts based on numerous peer review comments, with the assistance of review editors who were responsible for ensuring the comments were appropriately taken into account. One of the most difficult issues authors had to address was criticisms that the report was too negative. In a scientific review based on empirical evidence, this is always a difficult comment to handle, as criteria are needed in order to say whether something is negative or positive. Another difficulty was responding to the conflicting views expressed by reviewers. The difference in views was not surprising given the range of stakeholder interests and perspectives. Thus one of the key findings of the IAASTD is that there are diverse and conflicting interpretations of past and current events, which need to be acknowledged and respected.

The Global and Sub-Global Summaries for Decision Makers and the Executive Summary of the Synthesis Report were approved at an Intergovernmental Plenary in Johannesburg, South Africa in April 2008. The Synthesis Report integrates the key findings from the Global and Sub-Global assessments, and focuses on eight Bureau-approved topics: bioenergy; biotechnology; climate change; human health; natural resource management; traditional knowledge and community based innovation; trade and markets; and women in agriculture.

The IAASTD builds on and adds value to a number of recent assessments and reports that have provided valuable information relevant to the agricultural sector, but have not specifically focused on the future role of AKST, the institutional dimensions and the multifunctionality of agriculture. These include: FAO State of Food Insecurity in the World (yearly); InterAcademy Council Report: Realizing the Promise and Potential of African Agriculture (2004); UN Millennium Project Task Force on Hunger (2005); Millennium Ecosystem Assessment (2005); CGIAR Science Council Strategy and Priority Setting Exercise (2006); Comprehensive Assessment of Water Management in Agriculture: Guiding Policy Investments in Water, Food, Livelihoods and Environment (2007); Intergovernmental Panel on Climate Change Reports (2001 and 2007); UNEP Fourth Global Environmental Outlook (2007); World Bank World Development Report: Agriculture for Development (2008); IFPRI Global Hunger Indices (yearly); and World Bank Internal Report of Investments in SSA (2007).

Financial support was provided to the IAASTD by the cosponsoring agencies, the governments of Australia, Canada, Finland, France, Ireland, Sweden, Switzerland, US and UK, and the European Commission. In addition, many organizations have provided in-kind support. The authors and review editors have given freely of their time, largely without compensation.

The Global and Sub-Global Summaries for Decision Makers and the Synthesis Report are written for a range of stakeholders, i.e., government policy makers, private sector, NGOs, producer and consumer groups, international organizations and the scientific community. There are no recommendations, only options for action. The options for action are not prioritized because different options are actionable by different stakeholders, each of whom have a different set of priorities and responsibilities and operate in different socioeconomic and political circumstances.

Central and West Asia and North Africa (CWANA) Summary for Decision Makers

The CWANA (Central and West Asia, North Africa) region is large and extremely diverse in natural resources, social conditions, and economic and human development. Significant differences also exist in national policies and patterns of integration into the world economy and global markets. Agricultural knowledge, science and technology (AKST) has developed unevenly across countries in the region.

Natural resources and biodiversity. About 85% of CWANA is dry, with high rainfall variability accompanied by frequent droughts. Most of the world's deserts are in this region. About half of the internal renewable water resources are below the threshold of 500 m^3 per inhabitant per year—considered as a minimum for development to take place (Figure CWANA-SDM-1). Agriculture is using more than 70% of all available fresh water, and inefficient use makes scarcity worse. Agriculture is also the main source of water pollution, with pesticides and nutrients draining into groundwater, waterways, wetlands and coastal waters [Chapter 2].

Most renewable groundwater resources in CWANA are already exploited and in some cases overexploited, thus deteriorating water quality. The region has a large reservoir of fossil groundwater that some countries have started using without any formal agreements among basin-sharing countries. Although most water resources are transboundary, cooperation is weak among riparian countries for jointly managing the shared resources, with the exception of the Nile and the Ganges basins [Chapter 1].

Because soil management is poor, large areas of agricultural land are degraded by wind and water erosion, nutrient depletion and soil salinization. Poor land use planning, continuing population growth and urbanization have all contributed to a progressive loss of agricultural land in most CWANA countries. However, many have implemented large-scale land reclamation projects, such as in areas adjacent to the Nile Delta in Egypt, where the farmland area increased from 2.3 million hectares in 1952 to 3.68 million in 1998 [Chapters 1, 2].

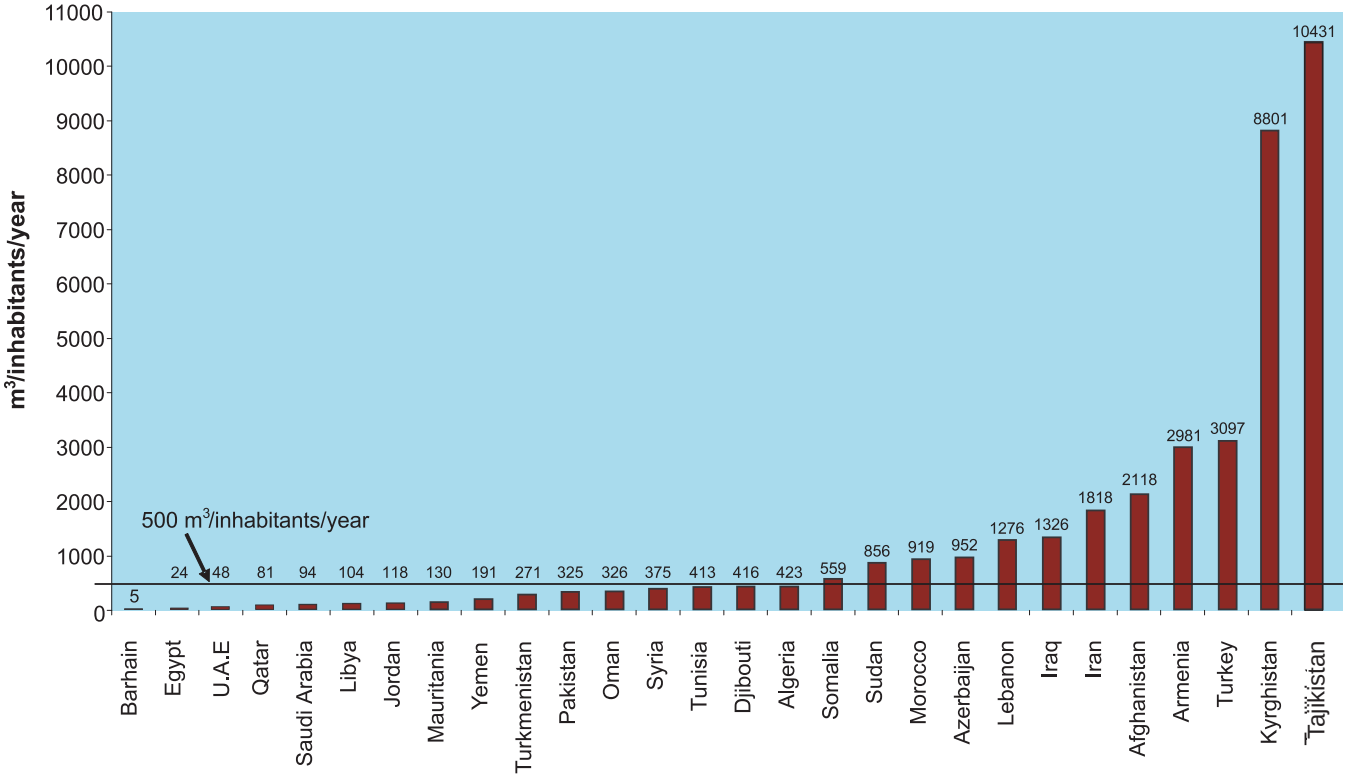

Figure CWANA-SDM- 1. *Internal renewable water resources in CWANA countries.* Source: FAO AQUASTAT database, 2007

Historically one of the world's most important centers for the origin of domesticated agriculture, CWANA is rich in unique biodiversity of animal and crop species and of medicinal plants. However, extended use of imported species and weak preservation policies are causing local genetic resources to disappear rapidly [Chapter 2].

CWANA holds some of the largest oil and gas reserves in the world, which makes the region attractive to international interests and interventions. The area also suffers from major international conflicts [Chapter 1]. Weak governance and poor human rights conditions have sparked ethnic wars in many CWANA countries. Relief and emergency interventions are widespread, especially in conflict zones.

Human development and social conditions. While increased access to education has led to major progress in some countries, access has remained limited in a large part of the region, because of poverty, lack of school infrastructure and type of livelihood, such as nomadic life and children's participation in farm work. In rural areas, the rate of illiteracy remains high, especially among women (for example, 80% in Morocco) [Chapter 1].

Active demographic policies have reduced population growth rates in some CWANA countries. However, these rates remain high in many others and are associated with high rates of unemployment. Despite important economic and social progress achieved in a number of countries, more than 40% of the people in the region live on less than US$1 a day, especially in rural areas, which contributes to increased outmigration. In addition, the uneven distribution of wealth and economic growth contributes to a shrinking middle class within most countries [Chapter 1].

Food and nutrition. CWANA countries vary significantly in per capita income and living standards. Overall progress has been significant in raising food consumption in kilocalories per person per day, thus improving the nutritional status of the population. However, hunger and malnutrition still prevail in some countries, particularly in rural areas and poverty belts [Chapter 2].

Animal products and cereals are the major sources of protein. Reflecting increased feed costs, the price of animal products has increased significantly, reducing their affordability. Dietary intake increasingly consists of legumes for protein and plant carbohydrates for calories in general. Nonetheless in some countries the demand for diverse agricultural commodities is increasing [Chapter 1].

Agricultural production and market integration. Occupying over 35% of total cultivated land in CWANA, cereals are the region's most important crops. Despite an increase in cereal production from 0.51 tonnes ha^{-1} in 1961 (excluding the countries of the Central Asia and Caucasus subregion) to about 1.73 tonnes ha^{-1} in 2005, yield increases in rainfed agriculture have generally remained less than the world average and the gap will probably widen in the near future as more marginal lands are cultivated [Chapter 2].

Only countries in the subregion of South Asia and West Asia have stabilized per capita production volumes; countries in the subregions of the Nile Valley and Red Sea and North Africa have seen per capita production fall quite sharply.

In contrast CWANA countries have achieved important progress in irrigated agriculture, reflected in increased production and yields. The production of vegetables has increased from about 20 tonnes ha^{-1} in the 1960s to 96 tonnes ha^{-1} in 2005, which represents 11% of world vegetable production, mainly concentrated in Southwest Asia (6% of world production) and the Nile Valley and Red Sea subregion.

Most CWANA countries are net importers of food, especially of cereals (Figure CWANA-SDM-2). Arab countries alone import US$20 billion in food. In 2004 agricultural imports in CWANA countries reached US$41.8 billion, while agricultural exports, mainly fruits, vegetables, dates and olive oil, did not exceed US$17 billion. The cost of attaining food security through imports is rising rapidly in relationship with increase in food prices [Chapter 1].

Farm structures and production systems. Existing land-tenure systems and farm structures in the CWANA region result from a combination of factors, including traditional land rights and customary law, colonial legacies and national policies. More recently, two major trends have characterized changes in farm structure in most of the region. On one hand, a higher degree of concentration of farmland is observed as a result of privatization, liberalization and economic hardship; but other farmland has become increasingly fragmented, mostly because of inheritance and demographic growth, leading to reduced economic viability of family farms and unsound land management [Chapter 2].

The large-scale farming system model based on high investment, monocropping and export-oriented production is consolidating at the expense of the small-scale diversified system. In the face of economic globalization and market liberalization, small-scale farmers in CWANA are becoming less competitive due to reduced subsidies, unfavorable prices, low productivity, lack of technical and marketing information, and adverse environmental conditions [Chapters 1, 2]. In CWANA the low level of investment in agriculture is closely associated with low labor productivity (value added per worker) (Figure CWANA-SDM-3).

Agricultural employment and women's labor. In recent years employment dynamics in the agricultural sector in most CWANA countries have been characterized by two major trends: (1) a significant decline in the share of the total active population engaged in agriculture, decreasing from an average of over two-thirds in the 1960s to less than one-third in several countries; and (2) the increasing participation of women in agricultural production [Chapter 2].

Despite their major and increasing contribution to agricultural production and rural livelihoods, women's activities have remained unacknowledged, under-recorded and undervalued, their identified roles mainly restricted to unpaid family labor and to cheap, seasonal wage labor. Because of the high illiteracy rate of rural women in some countries, agricultural extension has continued to target mainly male heads of household. Agricultural development programs have frequently failed to integrate women's needs and priorities or gender equity objectives, instead they frequently increase workloads for women by promoting the development of labor-intensive farming systems, such as intensive animal production and irrigated farming [Chapter 2].

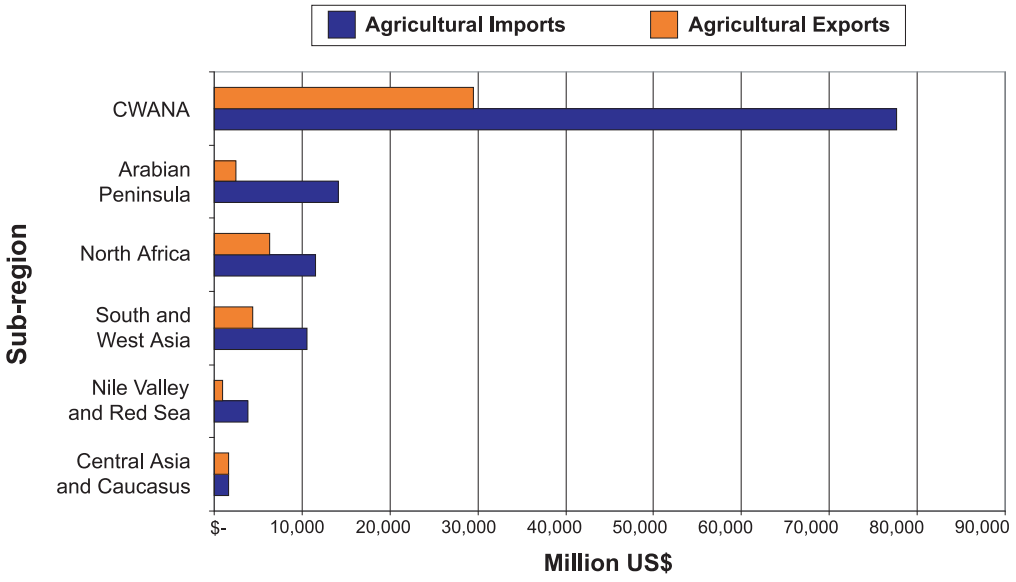

Figure CWANA-SDM-2. *Agricultural exports and imports for CWANA subregions.* Source: FAOSTAT.

Social and environmental costs of agricultural development. Technical models of agricultural modernization have resulted in major social and environmental costs in most CWANA countries. They have not only marginalized household-based farming systems but have also contributed to reducing employment opportunities, developing part-time farming, and increasing rural outmigration in most countries. Seasonal migration both between and within countries is common. In the Arabian Peninsula, Jordan and Lebanon, the proportion of the labor force made up of migrant workers is high in almost all sectors [Chapter 1].

Yet in absolute terms the rural population has dramatically increased due to persistently high population growth, thus amplifying pressure on both the labor market and natural resources. Food insecurity, exacerbated by drought, climate change and unemployment, will further intensify migration pressures in the future [Chapter 2].

Prevailing agricultural development models have led to pollution as well as contributed to growing health risks for both farmers and consumers. They have led to the overexploitation of land and water resources resulting in soil erosion, salinization, degraded rangelands, loss of local

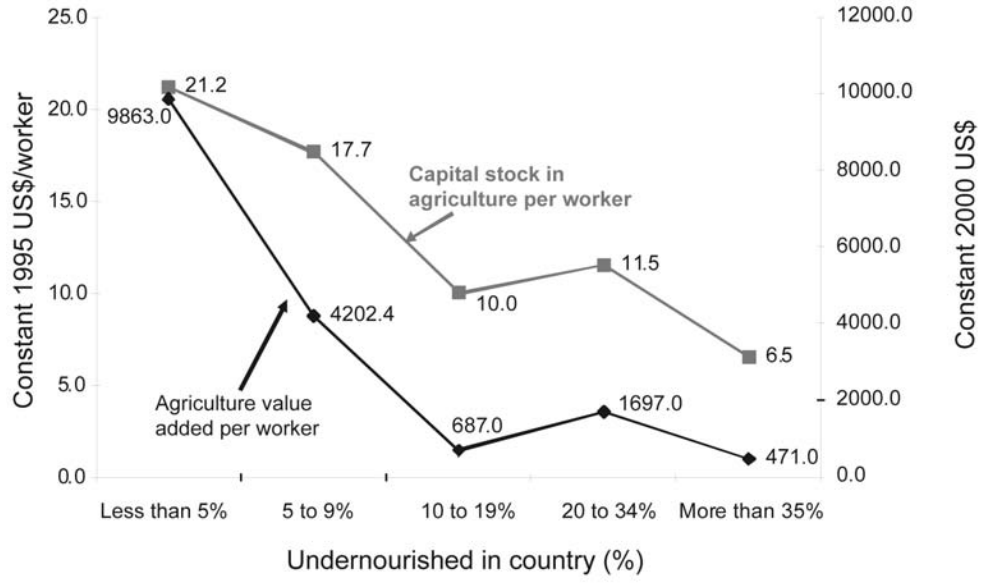

Figure CWANA-SDM-3. *Capital stock in agriculture and agriculture value added per worker in groups of CWANA countries.* Source: The state of food and agriculture: Food for food security? FAO, 2006.

agrobiodiversity and conflicts over the rights to use land and water [Chapters 1, 2].

Institutions. With few exceptions, poorly developed public policies have kept farmers' associations weak. Thus marketing channels are persistently poorly organized and technical support services are inefficient, presenting major obstacles in efforts to develop the agricultural sector.

Most CWANA countries rank low in all indices of good governance. Promoting development strategies that are more decentralized and participatory is hampered by insufficient political will and lack of effort to build organizational capacity in local communities. However, in some countries community-based organizations have started playing an important role in development activities such as household agricultural enterprises, community forests, water harvesting and environmental protection.

National Agricultural Research Systems

AKST has helped build sound knowledge of natural resources in most of CWANA and has also helped initiate a green revolution in a few countries. However, AKST has not always helped avoid degradation of natural resources (water, soil and biodiversity), alleviate poverty or reduce social inequity and has frequently overlooked the multiple functions of agriculture [Chapter **2**].

Public research has long focused mainly on crop genetic improvements, especially for wheat. More recently improved varieties of barley and grain legumes have been created and are being adopted in several countries (such as Egypt, Jordan, Lebanon, Tunisia), while adoption rates in other countries (such as Iraq and Morocco) remain low. Some crops, such as olives, have long been neglected and limited attention has been given to rangeland-based farming systems and to valuing local knowledge and resources [Chapter 2].

CWANA is in fact rich in traditional knowledge on aspects such as water harvesting and animal breeding. In the last decade, a number of initiatives have been developed to recognize, validate and maintain traditional knowledge. However, complete coverage is still lacking and the danger is that this knowledge will be lost if strong action to conserve and promote it is not taken.

Most agricultural research in CWANA has been carried out in a hierarchical fashion. Small-scale farmers have rarely been touched by conventional research programs, especially to adopt innovations. The social and economic sustainability of agricultural innovations or techniques has not been handled systematically. However, in some countries (such as Morocco and Tunisia) new strategies have been developed to localize research and adapt it to meet the needs of various stakeholders [Chapter 1].

Most recently, AKST has helped reverse trends that have been degrading water resources by promoting less exploitative water uses and techniques, identifying water-saving crops, breeding drought-resistant varieties and developing medium- and small-sized hydraulic works. However, little research has been carried out on the social aspects of managing water resources and only recently have initiatives been undertaken to strengthen the role of farmers' organizations in water management [Chapter 2].

Many CWANA countries have limited local expertise in policy formulation, institutional development and research management. Farming systems, knowledge systems and their dissemination [Chapter 1] are little understood, which becomes an important constraint in trying to elaborate appropriate policies.

Most investment in agricultural research and development (R&D) in CWANA is public investment; the contribution of the private sector remains generally low. Overall, resources allocated to research in CWANA countries are limited—less than 0.2% of GNP, although 1-2% is recommended. Recently, however, some countries such as Qatar, Tunisia and the United Arab Emirates have made real progress in promoting R&D. Private sector investment, except in a few countries) is nearly nonexistent [Chapters 1, 2].

A gap exists between the outputs from national and international agricultural research and their adoption at farm level. The capacity to transfer technology is weak, dissemination of information is poor and extension services are ineffective. Regional dissemination of experience has remained limited, because of insufficient cooperation within CWANA region. Yet a number of success stories could be scaled up and applied widely, such as women's empowerment (rights) in Tunisia, coping strategies (e.g., water-harvesting systems) in Palestine, agricultural input packages for small-scale farmers in Egypt and the international winter wheat improvement program in Kyrgyzstan [Chapter 1].

Challenges

Agricultural development strategies in CWANA are faced with major challenges: reducing poverty, securing food self-sufficiency, and gaining a better position in international markets while protecting the environment, ensuring good governance and social cohesion.

Adequate food supply for a growing population. One of the main challenges facing the region is to ensure a sufficient supply of food for a growing population in the face of limited and degrading natural resources likely to be worsened by climate change. Increasing agricultural production while keeping farmers in business and limiting rural outmigration stands as a major challenge.

Trade and market access for exports, changing market conditions. With the increased pace of trade liberalization and the rise of new standards, agricultural produce is facing increased market problems of access and competition vis-à-vis industrialized countries. Setting up adequate quality, social and environmental standards and instituting national policies on intellectual property rights will be major challenges for the future [Chapter 3].

Climate change and environmental issues. A major challenge for agriculture will be to minimize its negative effects on the environment, such as land and water degradation and pollution. A second challenge will be to conserve endangered plant and animal species that can be of agricultural interest, as loss of biological diversity will adversely affect food production [Chapter 3].

Developments in AKST will have to ensure that agri-

cultural systems are able to respond to the consequences of climate change, as these changes will severely affect agriculture (reduced water availability, shortened growth period, etc.) especially in low-income regions.

Ensuring an adequate supply of irrigation and drinking water, in the context of growing competition for this vital resource and more frequent droughts, will be another major challenge in the region over the next 30 years. Preventing water degradation will also be imperative, as water quality is increasingly at risk because of heavy withdrawals of groundwater and pollution from surface sources.

In CWANA, the issue of agriculture producing bioenergy is controversial and unpredictable, because it has adverse implications for the sustainability of food production, food security and natural resources (i.e. water, land, biodiversity). A major regional challenge is to make countries aware of what bioenergy or biofuel production puts at stake and to put in place policies to protect the food production function of agriculture [Chapter 3].

The hazards of pollution and how it adversely affects on human health are results of the expansion of intensive agriculture and the concurrent increase in the use of agrochemicals. A major task is to increase awareness of these hazards and hasten adoption of integrated pest and disease management [Chapter 3].

Plant breeding for resistance to biotic and abiotic stress presents a major challenge. Traditional breeding together with biotechnology should contribute to addressing this challenge. Genetically modified organisms are expected to gain greater attention and be subject to debate involving broader segments of society. The effects on human health, biodiversity and rural societies will have to be analyzed, taking into account what has occurred in other countries, to adopt adequate measures to handle the biosafety issues by developing and implementing national regulatory frameworks in the light of the Cartagena Protocol on Biosafety [Chapter 3].

Women in agriculture. Despite their substantial role in agriculture, women continue to have limited ownership and control over resources such as land, labor, credit and capital. Empowering women by providing enabling environments through policy, regulatory and legislative interventions for enhanced access to opportunities (e.g., education, access to natural and economic resources and technologies, enterprise development, participation in decision-making) will be a major condition for increasing agricultural productivity. Central to the formulation of future policies is the need to address the social sustainability issues related to women's labor conditions (e.g., safety, drudgery, excessively low wages) [Chapter 3].

Policies and governance. Policies for managing agricultural risk in CWANA have consisted mainly in implementing emergency measures, especially to cope with the consequences of drought and epidemiological situations, and of programs aimed at improving farm production techniques. However, what most countries of the region need is to design and implement a comprehensive and proactive risk management policy.

Options for Achieving Development and Sustainability Goals through AKST

AKST for Various Challenges Facing CWANA

One response to the multiple challenges of globalization, food insecurity, hunger, poverty, low agricultural productivity and endangered socioeconomic and environmental sustainability in the region is to use AKST effectively. While adjusting to the requirements of economically, socially and environmentally sustainable development, the CWANA agricultural research portfolio should not lose its focus on the existing conventional agenda; extension should be activated toward achieving the above objectives.

Requirements for fulfilling development and sustainability goals

Given the various AKST options available to deal with the challenges facing CWANA, it becomes extremely important to keep in mind some of the requirements without which AKST may not achieve development and sustainability goals effectively.

Governance. To ensure that the generation and application of AKST is truly geared toward development and sustainability goals, CWANA countries will have to provide transparent and participatory mechanisms to develop relevant policies and implementation mechanisms that follow the principles of good governance. To make AKST work for CWANA's people, changes must be made from business as usual [Chapter 4].

Investment. A substantial increase in investments in human and financial capital is urgently needed to address the identified challenges through AKST in the region, (i.e., a minimum of 1% of GDP, as recommended in the 2006 Khartoum Summit of Heads of State). Agricultural productivity improvements and natural resource preservation will depend on focused public and private investments in AKST to contribute to poverty alleviation, food security, environmental sustainability and economic progress. While there is a serious need for private–public and inter-regional partnerships, it is also important to ensure that the various sources of funding do not stop national agricultural research systems in the region from focusing on national agricultural priorities [Chapter 4].

Compliance with food safety and quality assurance. Compliance with standards has been relatively slow in CWANA countries and has mostly been in response to requirements of importing countries and the need to maintain traditional export markets. People's sensitization and strict enforcement of legislation are major conditions for assuring food safety and adopting new standards. In addition to preparing to meet these international standards, developing intra-CWANA standards is crucially important [Chapter 4].

Coordination and policy coherence. Promoting participatory and culturally sensitive and multidisciplinary approaches

involving all stakeholders (including regional institutions) is a key element in fostering AKST systems locally, nationally and regionally. AKST effectiveness within institutions will increase with better interaction among and within various government ministries (e.g., agriculture, food, livestock, marketing, commerce, finance, education), departments, academia, research, extension, the private sector, producer and grower associations, civil society organizations and the media. Without an integrated and cohesive approach, it will be difficult for CWANA to reap the true benefits of AKST [Chapter 4].

Policy options. Investment in support of agriculture in general is needed, and particularly capital for small-scale farms. Governments should set up regional, national and local mechanisms (long-term credit, incentives, etc.) to give farmers access to capital to buy tools and equipment and to better manage soil fertility and natural resources (water, land and biodiversity)—the final objective being to increase labor productivity and agricultural profitability.

In the face of globalization and increased market liberalization, agriculture in CWANA countries should be protected. Governments should set up mechanisms to support their agriculture as well as their farmers—border tariffs for staple products, or controlled prices for local staple products. Intellectual property rights for local niche products should be secured. A policy option could aim at increasing agricultural production and setting up local marketing arrangements. International prices of cereals are going up and many countries in the region will scarcely be able to afford grain. Thus fostering the production of staple food products at the national level is of crucial importance.

Among others, opportunities for organic farming are appearing, with the prospect of new value-added markets, knowledge for local products and increased protection for the environment. Organic farming for both export and local markets, however, requires well-planned national policies and regulations to meet required standards; these need further development and strengthening in the region [Chapter 2].

AKST for food security through increased agricultural production

Increased agricultural production through using AKST, accompanied by access to enough balanced food, is a major condition for attaining food security. AKST that helps increase productivity and quality in CWANA includes integrated water management, preservation and restoration of soil and soil fertility, integrated crop management, and development and use of high-yielding species and varieties (through conventional breeding and biotechnology) adapted to site-specific conditions (participatory decentralized breeding). Ecological, economic and social sustainability requirements should be an integral part of AKST policies aimed at increasing agricultural production and ensuring food security [Chapter 4].

AKST for improved livelihoods through diversified farming systems, improved livestock and aquaculture

Research aimed at promoting diversified farming systems models should be intensified, taking into account farm household needs and sustainability requirements. Preexisting mixed farming systems, which evolved in the region, may offer solutions to address existing challenges. Improved animal breeding and husbandry and aquaculture can generate income for many poor families in the CWANA region. AKST may thus reduce pressure on scarce resources, thereby preventing resource degradation and reducing the potential for conflict over diminishing resources. Increased livestock production must be based on intensified mixed systems, since excessive stocking rates on rangelands have already brought about widespread land degradation [Chapter 5].

AKST for overcoming water scarcity through integrated water resource management

Better use of the wealth of locally developed and modern technologies for improving the productivity of scarce water resources will allow for substantially higher agricultural production and reduced water use. Integrated water resource management aims at maximizing the benefits of managing water and related resources in an equitable manner, for different uses in all sectors, without compromising the sustainability of ecosystems. The potential for capturing currently untapped water resources exists through water harvesting, including lakes and large and small dams and groundwater recharge, and using unconventional sources such as reclaimed, recycled, brackish and desalinated water, and fog collection.

Managing water demand should include using water in irrigated agriculture efficiently; but it will also include building awareness, offering incentives and promoting the rational use of water through financial and economic measures such as water pricing, and considering the virtual value of water [Chapter 5]. One option for the coming decades is to characterize, maintain and protect local knowledge systems, especially those involving water-management techniques. [Chapter 3].

AKST for sustainable land management

Numerous practices and technological options fostering sustainable land management are available through both traditional and modern knowledge, adapted to site-specific conditions from the field to watershed scale. However, this information must be disseminated efficiently and a conducive environment (including a just land-tenure system) must be in place for these technologies to be adopted [Chapter 5].

AKST and conservation of biodiversity

AKST can capitalize on CWANA's rich biodiversity and counteract the threats that industrialized agriculture poses to it. Given the global changes occurring, particularly climate change, biodiversity may gain importance in crop and livestock breeding. Furthermore, markets capitalizing on biodiversity as a source of food, herbal remedies and income are gradually emerging. Some of the practices that may conserve or restore biodiversity include ecoagriculture, agroforestry, biodiverse protected areas and landscape elements, and adequate land-use planning including creating and maintaining protected areas. Gene banks should be

established or strengthened. They can capitalize on biodiversity by using genes from wild relatives of crop species and neglected landraces while at the same time they function to conserve that same biodiversity. The National Biodiversity Strategy and Action Plans developed through the Convention on Biological Diversity are intended to serve that purpose—to both conserve biodiversity and promote its sustainable use [Chapter 5].

AKST for adapting to climate change and managing risks

As an ecologically and economically vulnerable region, CWANA is particularly subject to the effects of climate change. Informed use of AKST will help mitigate and adapt to its effects. Better agronomic practices, conservation agriculture, cultivation methods that consume less water, and improved rangeland management as well as improved feeding of ruminants and manure management will substantially reduce greenhouse gas emissions and possibly increase carbon sequestration in CWANA. Capacity development may be required to successfully face the challenges ahead and may also help in gaining benefits from the flexible mechanisms included in the Kyoto Protocol (e.g., the Clean Development Mechanism) [Chapter 5].

Research related to climate change adaptation will need to focus particularly on drought-resistant crops and animal breeds, integrated pest and disease management (resistance, forecasting and modeling), and the introduction of adapted crops and varieties. Erosion control, floodwater management and ways to cope with saltwater intrusion will probably have to receive additional attention, and efficient management of scarce water will become even more important [Chapter 5].

Comprehensive and proactive risk management policies are urgently needed in the region. These policies include establishing early warning systems, developing crop insurance schemes, improving investment in infrastructure for water management and agricultural extension, implementing policies that protect human health and the environment and that discourage cultivation of marginal land, reinforcing marketing systems, and promoting farmers' organizations [Chapter 2].

AKST and emerging markets

The improvement of market organization and infrastructure in CWANA countries will enable stakeholders in agricultural value chains to capitalize on increased agricultural production. Producers, processors and traders need access to credits, markets (e.g., by closing the gap between rural areas and urban centers) and reliable market information, particularly in view of more diversified and market-oriented production. Appropriate technologies and infrastructure are required for value chains to function well. Adapted processing techniques and facilities at different levels may substantially reduce postharvest losses. Agribusiness can be developed to provide additional income along the value chain, particularly if diversified production focuses on nonstaples targeted at newly emerging market opportunities (e.g., organic products, supermarkets). Vertical integration and professional value-chain management are required to ensure good quality and safety management along the chain and compliance with newly emerging standards [Chapter 5].

Improving System Performance of AKST

AKST to strengthen and reorient capacity development

A self-reliant research policy is required to strengthen domestic AKST capacity in CWANA countries that are deficient in local expertise in formulating policy, developing their institutions and managing research [Chapter 5]. Stringent intellectual property regimes give monopoly rent to the countries that have access to capital, knowledge and information, to the disadvantage of the developing countries like those in CWANA.

Building partnerships for more efficient AKST systems

Links and collaboration among education, capacity building, research and extension institutions and farmers as well as interaction with the private sector may make AKST more efficient and effective. AKST monitoring and evaluation systems allow for continuity of priority setting and sound local, national and international strategy development [Chapter 5].

Using information and communication technology for transfer of technology and knowledge

Information and communication technology (ICT) will to a great extent enable CWANA to take advantage of the wealth of information and knowledge available from AKST. ICT infrastructural development and Internet connectivity will improve the sharing, exchange and dissemination of information and knowledge. In addition, modern technologies such as GIS, simulation modeling and expert systems will make possible better use of existing information [Chapter 5].

Investments in ICT infrastructure and capacity development together with adequate information policies will strengthen links among AKST stakeholders in education, research, extension and production. Such investment should reduce duplication of research activities and improve the effectiveness of research on the one hand, and enable stakeholders in AKST systems to make use of the latest technologies on the other. Access to up-to-date market information can assist decision-making at various levels [Chapter 5].

Reorienting approaches in AKST systems to address the diversity of farmer conditions and social demands

Agricultural education, research and extension will need to incorporate technological development into more holistic approaches, using integrated systems that are gender sensitive and based on local knowledge. To better address the diversity of farmers' conditions and consumers' needs, greater consideration should be given to socioeconomic aspects and participatory approaches. Risk issues should be integrated and ways to manage farm risk should be considered. The role of farmers' groups in value chains needs to be strengthened [Chapter 5].

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—Professor Bob Watson, director, IAASTD

The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) , on which *Agriculture at the Crossroads* is based, was a three-year collaborative effort begun in 2005 that assessed our capacity to meet development and sustainability goals of:

- Reducing hunger and poverty
- Improving nutrition, health and rural livelihoods
- Facilitating social and environmental sustainability

Governed by a multi-stakeholder bureau comprised of 30 representatives from government and 30 from civil society, the process brought together 110 governments and 400 experts, representing non-governmental organizations (NGOs), the private sector, producers, consumers, the scientific community, multilateral environment agreements (MEAs), and multiple international agencies involved in the agricultural and rural development sectors.

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