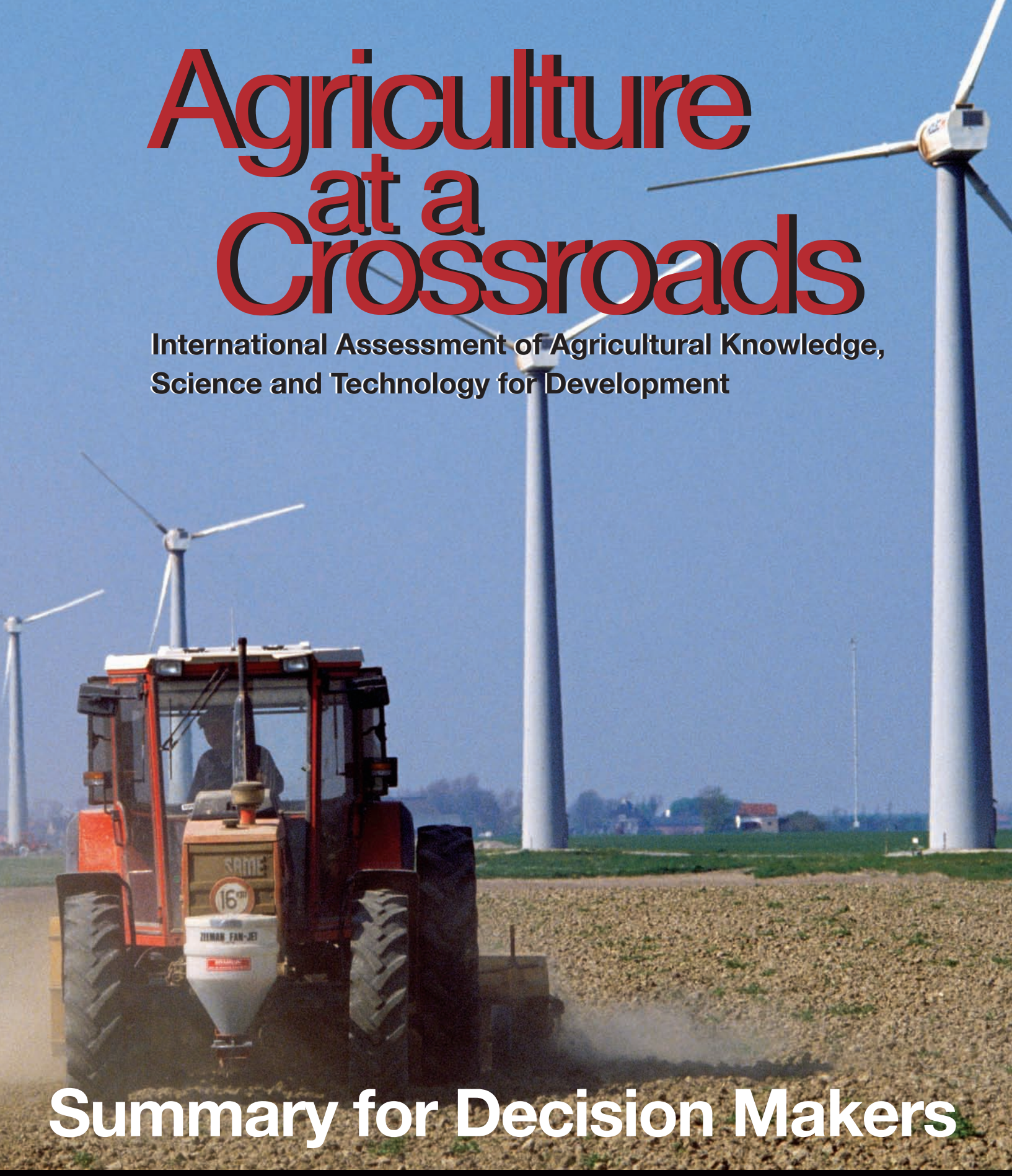
Agriculture at a Crossroads

International Assessment of Agricultural Knowledge, Science and Technology for Development



Summary for Decision Makers

IAASTD

North America and Europe

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International Assessment of Agricultural Knowledge, Science and Technology for Development

Summary for Decision Makers of the North America and Europe (NAE) Report


IAASTD
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IAASTD

International Assessment of Agricultural Knowledge, Science and Technology for Development

Summary for Decision Makers of the North America and Europe (NAE) Report

This summary was approved in detail by NAE 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.

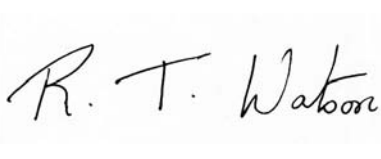
We acknowledge with gratitude the governments and organizations that contributed to the Multidonor Trust Fund (Australia, Canada, the European Commission, France, Ireland, Sweden, Switzerland, and the United Kingdom) and the United States Trust Fund. We also thank the governments who provided support 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



Director
Robert T. Watson

North America and Europe (NAE) Summary for Decision Makers

Writing Team: Molly Anderson (USA), Michael Appleby (UK), Marianne Lefort (France), Peter Lutman (UK), John Stone (Canada)

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 North America and Europe (NAE) Summary for Decision Makers.

Armenia, Finland, France, Ireland, Republic of Moldova, Poland, Romania, Sweden, Switzerland, United Kingdom of Great Britain (10 countries).

While approving the above statement the following governments did not fully approve the North America and Europe (NAE) Summary for Decision Makers and their reservations are entered in Annex A.

Canada and *United States of America* (2 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, Kenya 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 multithematic, 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 is 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.

Key Messages

1. Within North America and Europe (NAE), the development and application of agricultural knowledge, science and technology (AKST) have been successful in enhancing land and labor productivity and increasing production. However, the models of agricultural and rural development applied in the region have not fully eradicated hunger and rural poverty nor ensured sustainable ecosystem services, equity across gender and social divides, and sustainable rural livelihoods for those dependent on agriculture. To achieve development and sustainability goals, serious gaps in AKST need to be filled.

2. Successfully meeting development and sustainability goals and responding to new priorities and changing circumstances will be facilitated through widespread recognition of a paradigm shift, which accords increased importance to the multifunctionality of agriculture and adapts to local environmental and sociopolitical contexts. A multifunctional approach is appropriate at global, regional and local scales.

3. Major global issues pose challenges to agrifood systems everywhere due to the increasingly interconnected global economy and society. Among the most significant of these are climate change, energy demand, new diseases, weeds and pests, concentration of land ownership and agribusiness control, and the need for improved trade rules and markets. Relevant options include reducing greenhouse gas emissions and agrifood system vulnerability to climate change, and developing and evaluating second and later generation biofuels, as well as policy and governance options such as balancing the influences of government, private sector and civil society, and providing fair access to markets and just compensation for products and labor.

4. Continued attention to productivity combined with greater emphasis on the environmental, social and economic sustainability of food and farming systems and an explicit focus on health will contribute to meeting development and sustainability goals at the regional and local levels. Research is needed in ecological and evolutionary sciences applied to agrifood systems to devise and improve management to support multiple roles of crop and livestock production systems, forests and fisheries in order to maintain ecosystem services, such as supplying clean water, sequestering carbon, preserving biodiversity and providing food sustainably. Achieving development and sustainability goals will require intensifying the focus on nutrition, health and food quality.

5. Successfully meeting development and sustainability goals at global, regional and local scales will rely on three basic enabling strategies taking into account the diversity of situations in the NAE region (Figure NAE-SDM-1).

- *Reshaping knowledge systems* by building meaningful interdisciplinarity, developing interactive knowledge networks, increasing multiple stakeholder participation, integrating local and traditional knowledge with formal scientific knowledge, and changing organizations to be more responsive to different stakeholder needs.
- *Improving policy and governance* to encourage collaboration among diverse sectors and actors; protect and provide better access to public goods, such as clean water; and mitigate prior negative impacts of AKST, such as the impacts of land and agribusiness concentration on sustainable livelihoods.
- *Increasing overall public and private investments in AKST,* tailored to meet development goals within NAE and contributing to them globally. Public investment is especially expected to support public goods and reshape agricultural knowledge systems.

Multifunctionality

The term *multifunctionality* has sometimes been interpreted as having implications for trade and protectionism. This is *not* the definition used here. In IAASTD, multifunctionality is used solely to express the inescapable interconnectedness of agriculture's different roles and functions. The concept of multifunctionality recognizes agriculture as a multi-output activity producing not only commodities (food, feed, fibers, biofuels, medicinal products and ornamentals), but also non-commodity outputs such as environmental services, landscape amenities and cultural heritages.

The working definition proposed by OECD, which is used by the IAASTD, associates multifunctionality with the particular characteristics of the agricultural production process and its outputs; (1) multiple commodity and non-commodity outputs that are jointly produced by agriculture; and (2) some of the non-commodity outputs may exhibit the characteristics of externalities or public goods, such that markets for these goods function poorly or are nonexistent.

The use of the term has been controversial and contested in global trade negotiations, and has centered on whether "trade-distorting" agricultural subsidies are needed for agriculture to perform its many functions. Proponents argue that current patterns of agricultural subsidies, international trade and related policy frameworks do not stimulate transitions toward equitable agricultural and food trade relation or sustainable food and farming systems and have given rise to perverse impacts on natural resources and agroecologies as well as on human health and nutrition. Opponents argue that attempts to remedy these outcomes by means of trade-related instruments will weaken the efficiency of agricultural trade and lead to further undesirable market distortion; their preferred approach is to address the externalized costs and negative impacts on the environment, human health and nutrition by other means.

Context and Challenges

The application of AKST, supported by food supply–oriented policies since 1945, has increased productivity and production substantially within NAE, especially in western Europe and North America. Increases in total food production addressed much of the food shortage across NAE after World War II. Application of AKST has led to greater avail-

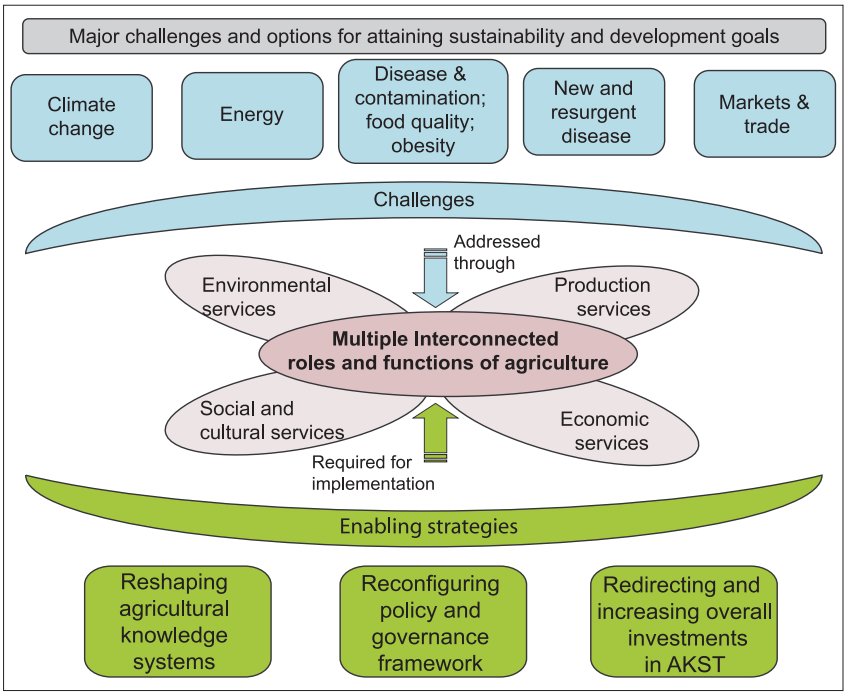


Figure NAE-SDM-1. *Major challenges and options for action.*

ability and variety of affordable food and, in some cases, to an overabundance of food [Chapters 2, 3, 4].

Despite the absolute quantity of calories available and decreased real price for food, poor households across the region cannot always access adequate and nutritious diets [Chapters 2, 3, 4]. In many cases agrifood practices, by which we mean the full range of activities from production to consumption, within NAE and other regions have contributed to environmental problems; increased inequity in wealth and assets in the food system; amplified vulnerability of livelihoods dependent on agriculture; and contributed to nutrition-related chronic diseases [Chapter 3]. The impacts of these problems have been exacerbated by power inequities within and between countries and AKST generated in NAE has failed to benefit the poorest within the region and externally to the same extent that wealthy actors have benefited [Chapters 1, 2, 4].

NAE agrifood systems thus still face major challenges that will affect development and sustainability goals, both within NAE and globally [Chapter 6]. Some of these challenges require new knowledge and technologies, and some require new policies and ways of using existing knowledge and technologies.

One of the major global issues of future decades will be developing agrifood systems that mitigate and respond better to the conditions expected because of climate change, such as increased temperatures and frequency of extreme weather events. NAE could play a leading role in this domain. NAE also has a key role in dealing with new and resurgent diseases, due in part to climate change and the globalization of the agrifood industry. Another area in which AKST can contribute is reducing the dependence of the NAE region on petroleum-based fuels by increasing energy efficiency and developing alternative sources of energy. In part because the NAE region has supported the implementation and development of agricultural activities in many other regions and imports multiple agricultural products from these regions, a major challenge for the next 50 years will be to determine how the NAE region can best contribute to sustainable environmental, economic and social development in these regions.

To address local and regional challenges in NAE and sub-regions, future agricultural research and development as a whole must deal with the multiple functions of agriculture explicitly and directly [Chapters 4, 6]. This will involve contributing to global food security and ensuring food security within NAE through continuing abundant food production and increasing equitable access to safe, reliable food supplies [Chapter 1], while ensuring sustainable ecosystem services, such as the provision of biodiversity and balanced nutrient cycling. In addition, multifunctional management will improve equity in agrifood sectors across gender and social divides and create and sustain rural livelihoods [Chapter 1]. A few examples of specific challenges that must be addressed to achieve multifunctional and sustainable food and farming systems are reducing pollution of land, air and waterways; maintaining soil health, and in particular dealing with fertilizer run-off and animal waste from very large-scale intensive operations; raising animals more humanely; dealing with new food-borne diseases and reducing food contamination; addressing land concentration, declining numbers of farmers and their increasing age; addressing the centralization and concentration of agribusiness control over processing, distribution and marketing of agrifood inputs and products; preventing obesity and diet-related diseases; and promoting markets with fair access and compensation to participants [Chapters 1, 3].

The severity of these challenges varies considerably across sub-regions and populations in NAE. For example, sustainable livelihoods are particularly problematic for mi-

grant workers in agriculture; and food insecurity is especially pressing in parts of eastern Europe (Figure NAE-SDM-2).

Successfully addressing these challenges and developing sustainable food and farming systems requires three basic enabling strategies: reshaping agricultural knowledge systems; improving policy and governance frameworks; and redirecting and increasing funding overall.

The IAASTD considers future alternatives for addressing the challenges mentioned above and their implications for development and sustainability. In choosing among alternative options decision makers need to recognize trade-offs and realize that solutions appropriate at one scale may have undesirable effects when scaled up or down.

Addressing Global Issues

Increasing demands on ecosystems to meet an array of needs of a rapidly growing world population and compensate for environmental degradation in some regions have led to new global issues. NAE's agricultural activities greatly influence the capacity of countries in other regions to meet development and sustainability goals. This is largely due to NAE's volume and variety of exports and imports and the many extended value-chain networks based in NAE that control major AKST resources. NAE generated and first adopted many advances in AKST, so this region shows the impacts of specific forms of AKST over the longest period and can provide illustrative lessons on its application and consequences, intended and unintended [Chapters 3, 4].

Among the global issues, four important new challenges stand out: climate change, making a transition to renewable energy sources, dealing with new and resurgent diseases, and reforming markets and trade to serve development and sustainability goals [Chapter 5].

Agriculture is both a contributor to human-induced climate change and is affected by changes in climate. It is a sizable contributor to greenhouse gas emissions (in the range of 7-20% of total NAE country emissions), especially methane and nitrous oxide. It is a major user of water in arid and semi-arid areas. Increasing temperatures, more erratic precipitation patterns and increased risks of droughts, floods, pests, weeds and diseases coupled with a northern shift of cropping zones will lead to changes in agricultural systems and production regions. Extreme events and the accumulated effects of anticipated impacts will severely challenge adaptive capacity [Chapters 3, 5].

Bioenergy, including the production of liquid fuels from biomass, could meet some of the region's growing energy needs. In recent years, liquid biofuel production has dramatically increased in importance and application. For instance, the use of wheat to produce bioethanol in the EU is set to increase twelvefold to reach some 18 million tonnes by 2016; and maize use in the US for the same purpose is expected to increase from 55 million tonnes in 2006 to 110 million tonnes in 2016. Across much of the NAE region the replacement of fossil fuels with biofuels has been subsidized and encouraged through policies that have spurred the production of bioethanol and biodiesel (mostly from maize and oilseed rape), though these feedstocks are not as energy efficient as others or economically viable without subsidies. While the increased demand for crops has generated higher crop prices and farm income, production of biofuels from

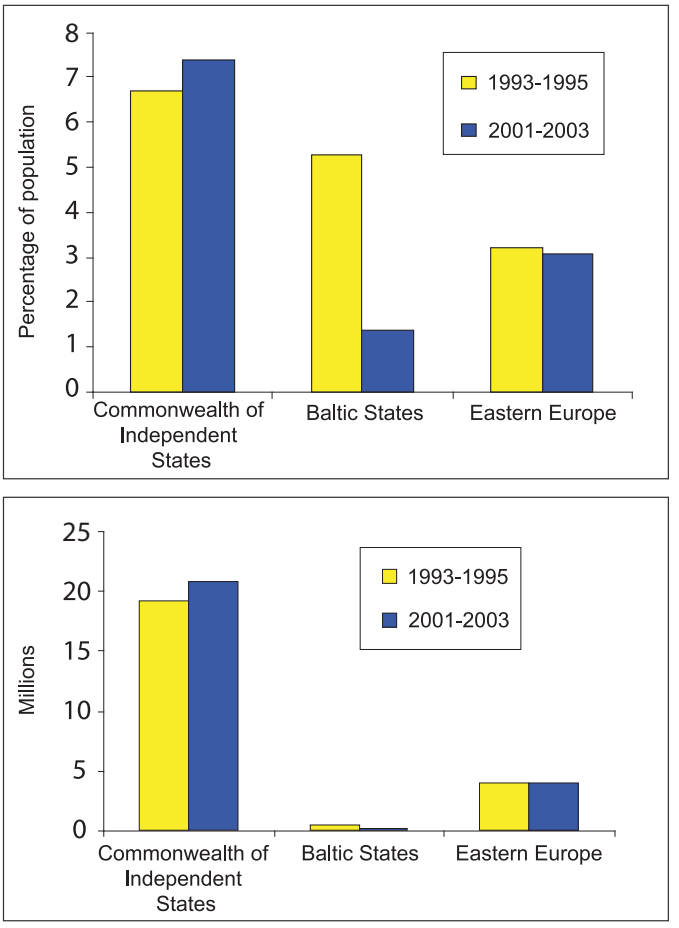


Figure NAE-SDM-2. *Food insecurity in countries in transition.* Source: FAO, 2006.

food crops is affecting food availability, food prices, and crop production patterns both within and outside NAE. In addition, the production of biofuels is encouraging production on lands previously reserved for conservation purposes with likely undesirable environmental and social effects. [Chapters 2, 3].

The last few decades have seen an alarming increase in new or resurgent diseases, such as Bovine Spongiform Encephalopathy (BSE) and avian influenza. One reason for this increase is the greater exposure of humans to infectious agents through changes in lifestyle, international travel and commerce, migration, increased human encroachment on forested areas, and industrialization and globalization of the food industry. Adequate understanding of this increase and how to cope with it is still lacking [Chapter 6].

As a major importer (of commodities, labor and resources), exporter (of products and AKST), and investor, NAE has influenced food and agriculture systems and trade throughout the world. Some of NAE's current policies and patterns of trading with developing countries diminish their ability to feed their own people by undercutting prices of developing country farmers and delivering food aid that cuts out local and regional farmers. In addition many countries in NAE have made substantial investments in agriculture and associated institutions over the past century and developing countries have been unable to make comparable

investments [Chapter 4]. Therefore, opportunities for most developing country farmers to contribute to food security and rural livelihoods through local and international markets will require substantial investments in AKST. International policies by NAE countries that undermine the ability to meet development goals inside and outside the region have led to calls for food sovereignty by farmers and consumer organizations, i.e., the right of peoples and sovereign states to democratically determine their own agricultural and food policies [Chapter 1].

Political and economic isolation is not viable in today's world, but trade relations with other countries must not undermine development and sustainability goals within NAE or other regions. Local production and marketing systems that ensure food security in all regions should be enhanced at the same time that trade mechanisms are adjusted to support development goals [Chapters 3, 6].

Options for Action

Develop strategies to mitigate effects of the agrifood system on climate change. Reducing agricultural emission of greenhouse gases within NAE will require changes in farming systems, land use and practices throughout the agrifood system, such as increasing energy efficiency and carbon sequestration, changing livestock feeds and reducing fertilizer overuse [Chapter 6].

Develop strategies to reduce the vulnerability of agriculture to climate change. Adaptation will require changes in agricultural land use patterns and cropping systems, more efficient water use and shifts in production areas. Such adaptive strategies will draw from different sources of knowledge, such as advances in breeding (i.e., new drought, pest, temperature and salinity tolerant plants), and soil and water management [Chapter 6].

Develop and evaluate renewable energy sources, including second and later generation biofuels. Research is needed to improve the energy content of biofuel crops and other raw materials, such as agricultural and forestry waste, and to increase the overall energy efficiency of biofuel production and use. Alternative energy sources, including systems based on algae and cyanobacteria, must have positive energy and environmental balances and their production should not compromise world food supply [Chapter 6].

Develop interventions that help to prevent or improve the treatment and management of new and resurgent zoonotic, plant and livestock diseases, as well as weed and insect problems. The spatial and temporal dynamics of these diseases and pests need to be understood better and suitable surveillance and response networks developed, such as early detection and new tools for diagnosis and treatment including those based on biotechnology [Chapter 6].

Understand the processes and consequences of international trade and market liberalization and identify actions to promote fair trade and market reform. AKST development and use within NAE can achieve the following in both NAE and other regions:

- Viable production, processing, distribution and marketing systems that result in food security, and sustainable rural livelihoods;
- Improved access to and further development of local and global markets;
- Fairer trade and amelioration of market failures through eliminating trade distortions, and creating mechanisms for interactive knowledge and technology exchange relevant to trade and marketing between NAE and other regions with participation of international governmental, nongovernmental, trade and farmer organizations [Chapter 6].

Improve the sustainability of local and regional food and farming systems. There has been growing concern across NAE about environmental, social, economic and public health impacts of farming and food systems. Environmental impacts include the following:

- Widely practiced farming techniques have led to soil damage and erosion and loss of biodiversity and traditional landscapes [Chapter 3].
- Increased nutrient use has led to pollution of freshwater and marine systems with consequences such as large "dead zones" at the mouth of major rivers and increased human health risks [Chapter 3].
- Agricultural irrigation accounts for about 70% of all water use in many southern parts of NAE, depleting renewable freshwater supplies [Chapters 2, 5]. There are pressures to release water for other uses including nature conservation [Chapter 3].
- Fish cultured in coastal-water cages may overload the waste processing capacity of local waters and the production of fishmeal from marine species has strained fisheries. In addition, fish in aquaculture and mariculture populations may escape and transmit diseases to wild populations [Chapter 3].
- Genetically engineered (GE) crops, principally maize, soybean, cotton, and canola engineered for insect resistance or herbicide tolerance, have been adopted in North America and elsewhere and, for some crops, have decreased insecticide use or increased conservation tillage [Chapter 2]. Weed populations tolerant to herbicides used in conjunction with certain herbicide tolerant crops have become an issue in some parts of North America, but options exist for their management [Chapter 3]. Public and scientific debate about the potential benefits and risks to the environment, economics and human health continue; and the evaluation and practical implications of the effects of transgenics, as well as its regulatory framework, remain controversial [Chapters 2, 3, 6].
- The long-distance transport of food (food miles) in NAE has increased because of the globalization of supply chains, advertising and increased consumer purchase of varied fresh food products, more prepared foods and out-of-season food products. Sourcing local food may reduce energy use in food chains, but reducing food miles is not by itself a reliable indicator of overall en-

ergy or economic efficiency; this requires a complete life-cycle analysis [Chapter 3].

Social, ethical and economic impacts include the following:

- Food safety and animal health problems have had widespread impacts because of the increasing scale of production and processing units. In response to breakdowns, the NAE region has developed far-reaching regulatory mechanisms to detect and prevent the spread of pathogens, parasites, pesticides and chemical residues. Some vertically integrated food industries have developed their own standards for food quality, safety and animal welfare to reduce risk, increasing pressures on farmers to produce to high quality standards, sometimes without compensation for increased costs involved [Chapters 2, 3].
- Livestock rearing practices have elicited concern about their impacts on animal welfare and customers are increasingly supporting more ethical management practices through purchasing behavior [Chapter 3].
- Concern about appropriate diets has increased as agrifood systems have shifted toward provision of more processed, convenience and take-away foods [Chapter 2]. The rapid rise of obesity and diet-related diseases in NAE (Figure NAE-SDM-3) is due to the interaction of various factors: the general abundance of food; a high degree of marketing and advertising of foods with low nutrient density that are high in sugars, fats and salt; changes in processing technology; lifestyle and dietary choice [Chapter 3].
- New quality demands on farmers, low commodity prices in the past, price fluctuations and reform of agricultural policies have until recently reduced the financial rewards for farm production in many parts of NAE with economic and social consequences for those whose livelihoods depend on agriculture but sometimes with benefits to consumers. The impacts of recent increases in commodity prices have not yet been fully analyzed [Chapter 3].
- Farming in parts of eastern Europe has been strongly affected by withdrawal of government support and some rural populations experience persistent poverty and isolation [Chapter 3].

Options for Action for Increasing Sustainability of Local and Regional Agrifood Systems

Enhance research in ecological and evolutionary sciences applied to agrifood systems to devise and improve management options to support multiple roles of agriculture. Such options call for a more interdisciplinary, ecological and evolutionary approach to agroecosystems for better water, soil, livestock and biodiversity management at landscape scales and improved preservation of genetic resources. Specific promising practices include many organic methods, ecologically based pest management, conservation tillage, composting and precision farming [Chapter 6].

Improve standards of soil and water management, including irrigation, to increase water efficiency. Better understanding of soil and water processes requires integration of scientific and local knowledge. Technologies that enable farmers to adapt to results of climate change, such as increased droughts and higher temperatures, are particularly in demand [Chapter 6].

Strengthen breeding activities, further developing relevant technologies including biotechnologies. Breeding on a wide diversity of varieties and species is essential for improved productivity, changes in consumer demand, resistance to disease and adaptability to different environmental conditions. This breeding must take into account both the local environment and crop and animal management systems. Basic sciences, such as functional genomics and systems biology, are of continuing importance in plant and animal breeding. The development of biotechnologies, such as genetically engineered organisms that exploit progress in basic science, must be comprehensively assessed for the impact of their deployment on a wide scale and a suitably long-term basis [Chapter 6].

Assess impacts of management systems on animal welfare, and develop and promote humane practices. Ethical standards of animal handling and slaughter and attention to the environment in which domestic livestock are raised can significantly reduce stress and suffering of domestic livestock and should be included in future management [Chapter 6].

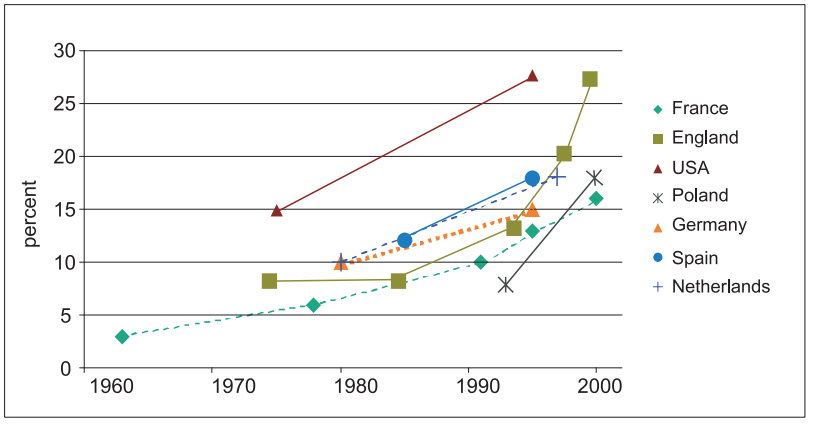


Figure NAE-SDM-3. *Increasing prevalence of overweight children in NAE.* Source: International Obesity Task Force, March 2005.

Explore, promote and manage the multiple roles of forests to conserve soil, maintain water quality and quantity, protect biodiversity and sequester carbon. Assigning value to ecosystem services and forest resources and improving long-term sustainability and resilience to environmental change will enhance forest stewardship and the livelihoods of people dependent on forest resources [Chapter 6].

Improve the sustainability of coastal capture fisheries and aquaculture. Fisheries and aquaculture management will benefit from ecosystem management and monitoring that reduce the ecological effects of fishing technology, facilitate selective fishing and create markets for by-catch. Aquaculture can be improved by better understanding the relationship between fish immunity and disease, and reducing effects of escapes on native fish. Reducing impacts of waste and developing more sustainable alternative sources of fish feed are also critical needs [Chapter 6].

Intensify the focus on human nutrition, health and food quality through diverse food and farming systems. Research and technological developments in food systems could produce deeper understanding of the relationships among food, diet and health; improve the quality of raw materials; reinforce abilities to prevent contamination and to trace along the food chain for quality and safety assurance; and influence behavioral change for healthier diets [Chapter 6].

Improve the sustainability of rural and community livelihoods. AKST can be applied to improve social welfare at the local scale through improved understanding of the factors affecting social welfare and the vulnerability of farming communities. These include institutions that govern access to and use of natural resources, and incentives and rewards for farmers and other actors in the food system. There is a need to evaluate the full range of agricultural goods and services, design economic instruments that promote an appropriate balance of private and public goods and assess the performance of farming systems (including alternative crops and enterprises) that accommodate the multifunctionality of agriculture [Chapter 6].

Comprehensively assess new technologies for their impact on the environment, economic returns, health and livelihoods. All new technologies (transgenics, nanotechnology, biofuel production, etc.) will benefit from thorough analysis with tools such as life-cycle impact analysis and social, economic and vulnerability impact assessment. In the past, the rapid application of technology before full assessment has led to unforeseen problems. New and relevant analytical tools that allow for the examination of effects on different stakeholders, different agrifood sectors, and different dimensions (e.g., environmental and social) are needed [Chapter 6].

Enabling Strategies Necessary for Addressing Sustainability and Development Goals

A. Reshaping agrifood knowledge systems

Agrifood knowledge systems include institutions, actors and networks (organizations, government agencies, etc.) working through processes such as knowledge generation, extension and capacity building and constrained by local, national and international rules and norms.

Efforts to streamline research in the last quarter of the twentieth century in some parts of NAE have had both positive and negative impacts on AKST. Restructuring of facilities in response to changes in scientific methods to take advantage of new economies of scale and to increase their scope generally has been beneficial. However, streamlining and a reduction in public funding have been criticized as contributing to serious fragmentation and weakening of the disciplinary research base [Chapter 4].

Strategic planning for public sector funding organizations has not always been well enough integrated or managed adequately at the national level to maintain crucial scientific expertise and facilities. With increasing frequency, competition and short-term contracts have been built into NAE public sector funding systems for AKST to ensure quality, transparency and efficiency. Short-term contracts may have reduced rather than increased efficiency because many types of agricultural research, such as breeding programs and environmental studies, require long-term commitments [Chapter 4].

Although NAE AKST has contributed to reducing hunger in NAE and other regions, it also has had adverse ecological and socioeconomic effects. In recent decades newer forms of AKST have mitigated some of the most detrimental impacts [Chapters 2, 3].[1]

Technology transfer has been far from successful in some areas [Chapter 4]. In recent decades, individuals, groups and organizations in some NAE countries have initiated new forms of AKST generation, access and uptake, such as participatory research projects with greater end-user participation and shared ownership of research products [Chapters 4, 6].

Facilitation and promotion of multifunctional agrifood systems will require building new capacity in current and future AKST personnel. Such an approach needs to involve a greater range of actors, such as producers, agribusinesses and end users, as well as researchers and extension specialists [Chapter 6].

Options for Action to Reshape Agrifood Knowledge Systems

Strengthen human capital and reconfigure organizational arrangements to facilitate the development, dissemination and wide use of AKST [Chapter 6].

- Reinforce interactive knowledge networks by involving multiple and more diverse stakeholders including researchers, educators, extension staff, producers and commercial businesses.
- Improve processes for involving, informing and empowering stakeholders, in particular women and others whose interests have not been adequately addressed previously.
- Enhance interdisciplinary cooperation in research, educational programs, extension and development work without compromising disciplinary excellence.
- Strengthen information and knowledge-based systems to enable a rapid, interactive flow of information and

[1] USA.

knowledge between the wider agricultural sector and the AKST system.
- Strengthen links between research and higher education and among researchers, farmers and other agrifood actors to promote lifelong learning and the development of a learning society.

Recognize more fully the important role that traditional and local knowledge plays in agriculture and in the culture and welfare of particular people. Respectful interaction with indigenous people, such as Native Americans, and other practitioners who are preserving local and traditional knowledge is essential. Their knowledge, experience and techniques can contribute to agrifood system sustainability, social justice and the development of new AKST. This change would include fair market compensation for financially valuable knowledge not in the public domain [Chapter 6].

Address gender related issues in agricultural research and the agricultural economy. There is great diversity in women's contribution to the agricultural workforce in Western Europe (Figure NAE-SDM-4). Issues include gender equity in research and educational institutions and in farm and land ownership [Chapter 4]. They also include problems posed by the necessity for supplemental off-farm income to support farming and by family fragmentation among migrant workers [Chapter 6].

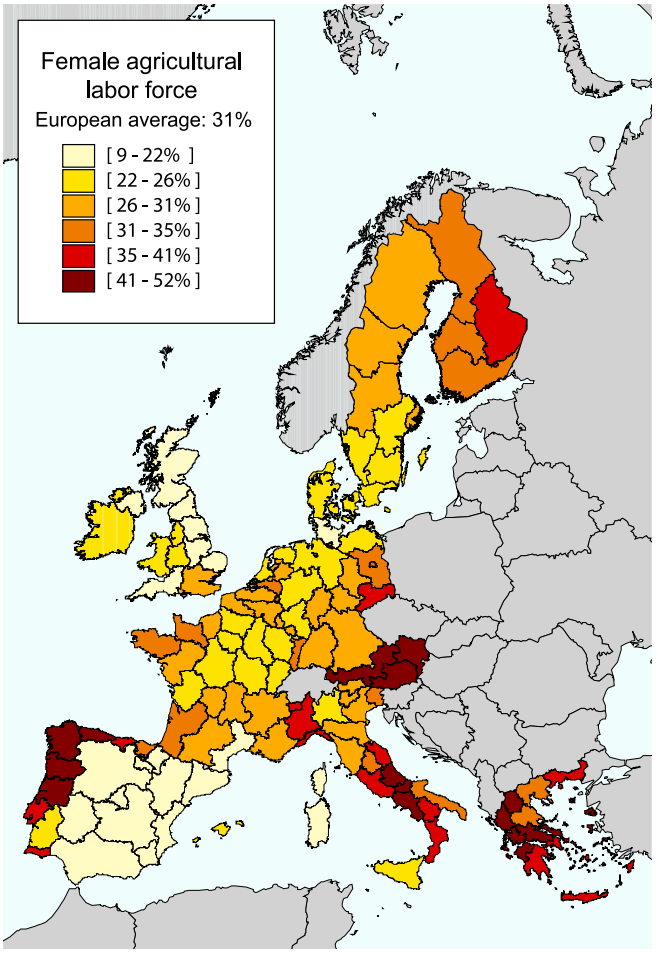


Figure NAE-SDM-4. *Share of women in permanent agriculture workforce in 1997 in EU.* Source: European Commission, 2002.

Acknowledge the influence of NAE in other regions of the world and reinforce partnerships between NAE and these other regions to empower poor and disadvantaged people and organizations. Interactive knowledge networks and integrated transdisciplinary research and educational programs can facilitate the development of relationships among AKST organizations worldwide. In addition, there is great need to strengthen working relationships between research and extension worldwide so that research results are utilized with documented success. There is also a need to encourage proposals from other regions (outside NAE) that consider both human capital and organizational arrangements and focus on capacity building. Regional and global fora can facilitate networking and promote enhanced contributions to the global knowledge economy by AKST organizations [Chapter 6].

B. Improving policy and governance

Agricultural policy decisions are made in a complex environment and are affected by policies outside agriculture, often resulting in disconnected and uncoordinated policies often with unintended and unanticipated consequences [Chapter 6].

The structure of agrifood systems in NAE has changed over the last few decades, becoming more vertically integrated from agricultural inputs through food retailing. The largest actors, including food retailing, service and processing businesses have predominant influence over the production, processing and marketing of food (Figure NAE-SDM-5). Partly as a result, food producers have become disconnected from consumers and markets in some parts of NAE and some supply undifferentiated bulk commodities into mass markets at low prices. The large majority of profits from processing and other strategies for adding value to meet consumer demands are captured by industries after the farm gate, not by farmers. At the same time ownership of land and breeding, agrochemical and fertilizer industries have become increasingly concentrated. For example, four NAE-based transnational companies provide almost 30% of the world's commercially available seeds and NAE accounts for 43% of the commercial seed market globally. Two firms provide most of the fertilizer used today in North America, while one firm has a 25% market share for fertilizers in Europe [Chapter 2].

Although citizens in some countries have the opportunity to contribute to their food and agricultural policies, these structural changes have led to calls for options for action elaborated under the rubric of food sovereignty [Chapter 3].

The increasing frequency of disturbances (environmental and economic) and the rigidity of highly centralized agrifood systems [Chapters 2, 3] suggest the need for more decentralized decision making to enhance adaptability and resilience.

Over the last few decades, agriculture's negative environmental externalities have led to a growing impetus to integrate environmental concerns more fully into agricultural policies [Chapter 3]. Although some countries have

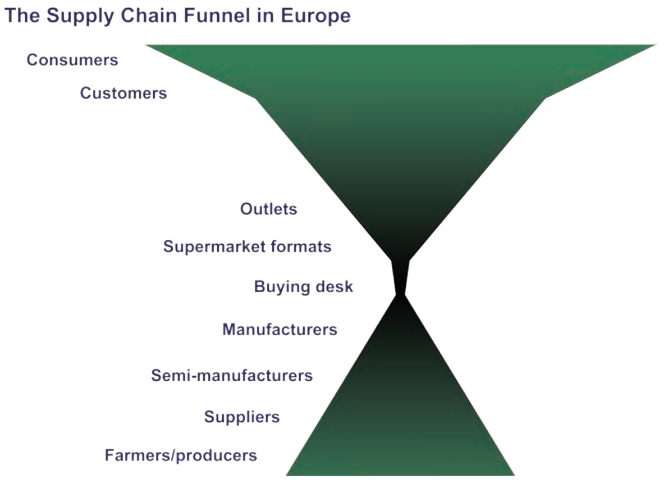


Figure NAE-SDM-5. *The supply chain funnel In Europe.* Source: Vorley, 2002, after Grievink, 2003.

experience in this policy domain, additional progress is needed.

The current systems of property rights for some resources essential to agriculture, such as land, soil, and water, do not take into account that these resources are part of the commons, or the collectively shared heritage on which human life depends.

The knowledge systems necessary for plant and animal breeding have been protected in part as intellectual property and increasingly privatized. Intellectual Property Rights have protected and encouraged industrial innovation. There are acknowledged difficulties in rewarding innovations by local communities and local food system actors using these instruments [Chapters 2, 3].

Options for Action to Improve Policy and Governance

Support coherent policy frameworks for agricultural and rural development and ensure that relevant government departments collaborate with private sector and NGO actors in their development [Chapter 6]. Coordination between government functions can facilitate a balance among the goals of feeding an expanding population, using natural resources efficiently and sustainably, and promoting economic development and cultural uses at the local, regional and global levels.

Strengthen connections among all actors within the food chain and better balance power among all actors in food chain governance. This requires policies to strengthen business and marketing skills among producers, build mutually beneficial relationships among all members of the food supply chain and educate consumers about farming and food products and systems.

Develop policy instruments to internalize current environmental and social externalities of agricultural production and reward the provision of performance-based agroenvironmental services. Examples include financial instruments to discourage use of environmentally harmful inputs and promotion of agricultural practices with low carbon emissions, watershed and landscape eco-management, and carbon sequestration through agroforestry.

Develop policy instruments that support diversity of scale in agricultural enterprises. These include anti-trust measures, improved competition policies, more stringent corporate social reporting and greater transparency in corporate transactions.

Conduct research to determine policy changes that will lead to improvement in the welfare of migrant and temporary farm labor. Immigrants with precarious legal status do much of the agricultural labor in NAE. Appropriate measures could improve the availability of qualified labor to agriculture while eliminating sub-standard wages and working conditions.

Develop regimes that define rights of use and of property. The development of "common property regimes" for scarce natural resources, such as water, that go beyond either public or private ownership could be considered. Public policy discussions of the nature and implications of future proprietary regimes may help further understanding and cooperation among stakeholders.

Devise modes of governance at the local level that integrate a wider range of stakeholders' perspectives. Examples such as food policy councils in the US and river basin management organizations that implement the European Water Framework Directive already exist to a limited extent in NAE and should be promoted.

Assess the impact of intellectual property rights and associated regulatory frameworks to facilitate the generation, dissemination, access and use of AKST by larger communities within and outside NAE. Several measures might arise from this option, such as cross-licensing of patents among universities, public institutions and the private sector; extension of patent exemptions to facilitate research; open source technology that can lead to collaborative invention; and incentives that promote local innovation.

Encourage greater international cooperation to achieve the development and sustainability goals. Topics for cooperation include climate change, biodiversity conservation and sustainable use, genetic resource conservation, control of persistent organic pollutants, desertification, sanitary/phytosanitary issues, intellectual property and biopiracy, women's and children's rights, and traditional and local knowledge.

C. Directing investments

Between 1945 and the mid-1970s there was a period of rapid growth in public agricultural research and development (R&D) expenditures in NAE. While the absolute amount of public funding for AKST research in most of NAE has continued to increase slowly, growth rates have declined [Chapter 4].

The proportion of private AKST in North America and Western Europe has increased significantly since World War II. This change has influenced the type of agriculture-related research conducted as well as the allocation of public fund-

ing for research, training and extension. The increase in private funding, especially for crop improvement, has moved the focus of NAE AKST toward market-driven goals and away from public goods [Chapter 4].

Large multinational companies increasingly influence directions, priorities and investments in AKST. Actions to achieve development and sustainability goals require the continuing and, in many cases, increased commitment of resources in AKST by a diverse range of actors including farmers, agribusinesses, engineering and biotechnology companies, food retailers, universities, governments and NGOs. It is vital that these private and public investors cooperate to enhance the welfare of people and communities in NAE and other parts of the world (Figure NAE-SDM-6) [Chapter 6].

Options for Action to Direct Investment in AKST

There is need for further investments and innovations in AKST:

- To meet future needs of NAE populations for food, feed, fiber and energy with prudent use of natural resources, protection of the environment and regard to the needs of other regions;
- To tackle the relative poverty and improve the social welfare of some NAE rural communities;
- To address emerging challenges facing agriculture such as climate change, loss of biodiversity, environmental degradation and food safety;
- To exploit the potential offered by new technologies and scientific discoveries including those originating in sectors other than agriculture;
- To develop knowledge and skills in technology change and management; and
- to strengthen institutional frameworks that govern the ways that AKST is developed, disseminated and used [Chapter 6].

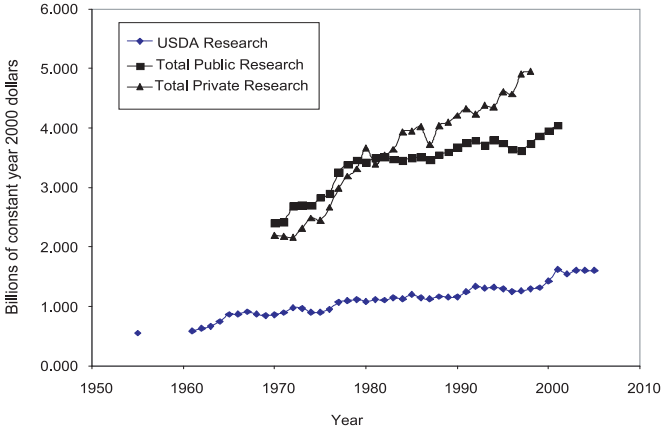


Figure NAE-SDM-6. *Funding for agricultural research in the US.* Source: USDA data from NSF, USDA ERS and US Department of Commerce.

Establishing a more multifunctional approach will entail an overall increase and more diverse funding and delivery mechanisms for AKST and human capacity building. Depending on circumstances, these could include:

- Public investment to serve the public good, addressing strategic, non-market issues such as food security and safety, climate change and sustainability that do not attract private funding;
- Public investment to strengthen human capital development, including multidisciplinary research;
- Private investment by agribusinesses and farmer associations as an important and growing source of new AKST;
- Adequate incentives and rewards to encourage private investment in new AKST contributing to development and sustainability goals, including support for commercial services such as market information and credit for new and socially disadvantaged farmers;
- Public–private partnerships to provide technical assistance and joint funding of AKST investments, especially where risks are high and where research developments in the private sector can significantly enhance the public good; and
- Provision in some countries through civil service organizations (CSOs) of complementary channels for public and private funding of technical assistance, knowledge transfer and applied research at the local scale [Chapter 6].

Improving the effectiveness of procedures for funding rural and agricultural development by national and international agencies. This recognizes the strategic role of the agricultural and rural sectors in meeting development and sustainability goals within NAE and globally, allocating funds and managing investment programs for these purposes [Chapter 6].

Annex A
Reservations by Governments

Reservations on SDM

Canada: The Canadian Government recognizes the significant work undertaken by IAASTD authors, Secretariat and stakeholders and notes the North America and Europe (NAE) Report Summary for Decision Makers as a valuable and important contribution to policy debate which needs to continue in national and international processes. While acknowledging the considerable improvement achieved through a process of compromise, there remain a number of assertions and observations that require more substantial, balanced and objective analysis. Given the diversity that exists between countries included in the NAE region, it is further noted that some of the statements and options while generally applicable, remain more pertinent to some countries than others. Notwithstanding, the Canadian Government advocates the report be drawn to the attention of governments for consideration in addressing the importance of AKST and its large potential to contribute to the development and sustainability goals of the IAASTD.

United States of America: The United States joins consensus with other governments in the critical importance of AKST to meet the goals of the IAASTD. We commend the tireless efforts of the authors, editors, Co-Chairs and the Secretariat. We welcome the IAASTD for bringing together the widest array of stakeholders for the first time in an initiative of this magnitude. We respect the wide diversity of views and healthy debate that took place.

As we have specific and substantive concerns in each of the reports, the United States is unable to provide unqualified endorsement of the reports, and we have noted them.

The United States believes the Assessment has potential for stimulating further deliberation and research. Further, we acknowledge the reports are a useful contribution for consideration by governments of the role of AKST in raising sustainable economic growth and alleviating hunger and poverty.

Reservations on Individual Passages

1. The USA believes that this paragraph undervalues the demonstrated ecological and socioeconomic benefits that have accrued through the use of AKST.

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Steering Committee

The Steering Committee was established to oversee the consultative process and recommend whether an international assessment was needed, and if so, what was the goal, the scope, the expected outputs and outcomes, governance and management structure, location of the Secretariat and funding strategy.

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—Professor Bob Watson, director, IAASTD

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

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