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Towards sustainable agriculture

Some Key Findings of the International Assessment of Agricultural Knowledge, Science and Technology for Development

Significant increases in food production over the 20th century have contributed to the improvement of many farmers' livelihoods and to economic growth.

However, the distribution of benefits from increased agricultural output has been inequitable. The gains have come with disproportionate environmental, cultural, health and social costs, depleting natural capital and degrading human well-being.

Agriculture in the 21st century will have to address crucial challenges in order to reduce global hunger, poverty and environmental harm, including climate change, by maintaining and enhancing environmental and cultural services, while increasing sustainable productivity, and safeguarding nutritional quality and the diversity of food and farming systems.

International Assessment of Agricultural Knowledge, Science and Technology for Development

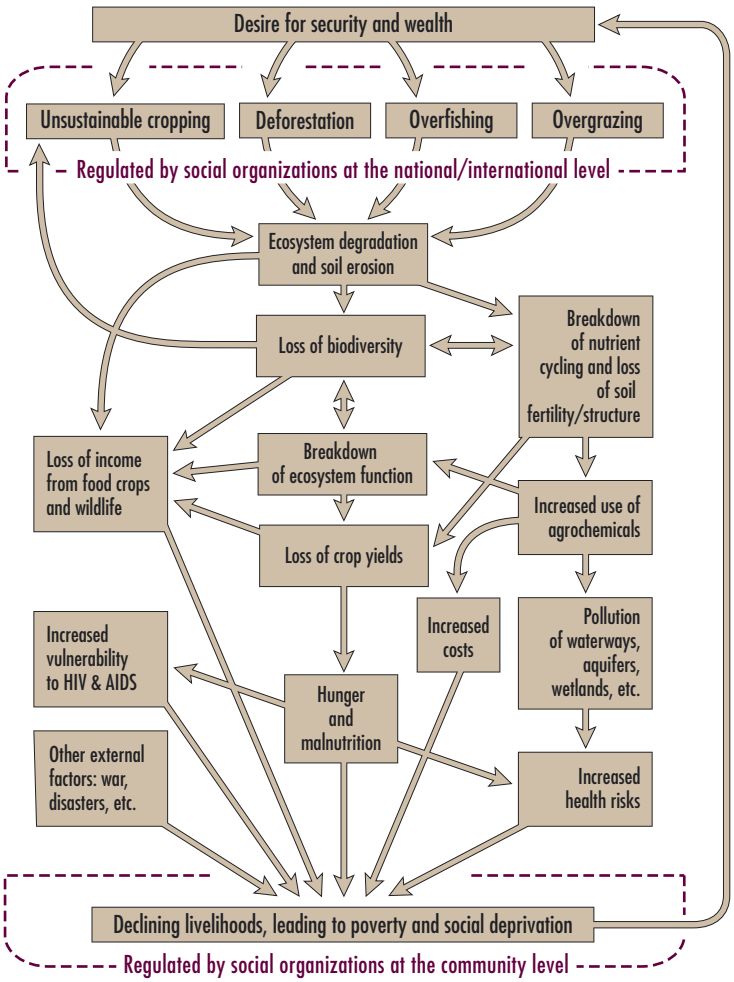
IAASTD

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

(IAASTD) took an objective view of the long-term challenges facing world agriculture and considered how these might be addressed by the development and appropriate use of agricultural knowledge, science and technology (AKST), learning from past experiences and current understanding. This policy brief presents some of the IAASTD key findings (#) and illustrates ways of addressing the challenges, highlighting relevant policy and institutional responses.

Environment, poverty and neglect of small-scale agriculture: an unsustainable nexus

Key finding: The environmental shortcomings of agricultural practice associated with poor socioeconomic conditions create a vicious cycle in which poor small-scale farmers have to deforest and use new, often marginal lands, so increasing deforestation and overall degradation. **(# 4)**



Modified from Leakey, R.R.B., Tchoundjeu, Z., Schreckenberg, K., Shackleton, S. and Shackleton, C. 2005. Agroforestry Tree Products (AFTPs): Targeting Poverty Reduction and Enhanced Livelihoods. *International Journal of Agricultural Sustainability* 3: 1-23.

SCALE OF THE GLOBAL ISSUES IMPACTED BY AGRICULTURE

Social Issues	
Effects	**Number of people affected**
Poverty Income less than US$2/day	3,200 million
Lack of micronutrients Deficiency in vitamins and minerals (especially Vitamin A, Iron and Zinc)	2,000 million
Overweight and obesity Unhealthy diets and lifestyle	1,000 million
Hunger Deficiency in calories and proteins	900 million
Underweight children Inadequate food intake and frequent illness	126 million
Vulnerability to disease Malnutrition weakens the immune system	60% of deaths due to infections and parasites
Environmental and Natural Resource Issues	
Effects	Area affected
Land degradation Loss of soil fertility	2,000 million ha (38% of the world's cropland)
Depletion of water resources Agriculture uses 70% of available global freshwater	2,664 km³ annual loss
Depletion of soil nutrients Nitrogen, Phosphorus and Potassium deficiencies	59%, 85% and 90% of harvested area respectively
Salinization Increased soil salinity due to water evaporation (10% of the world's irrigated land)	34 million ha
Loss of biodiversity and agroecological functions Deforestation and loss of vegetation cover, overgrazing and overfishing	US$1,542 billion /annually
Increasing water pollution Reduced water quality in rivers	1.5 billion people lack safe drinking water
Climate change Increased greenhouse gas (GHG) emissions	Agriculture responsible for 15% of GHG emissions

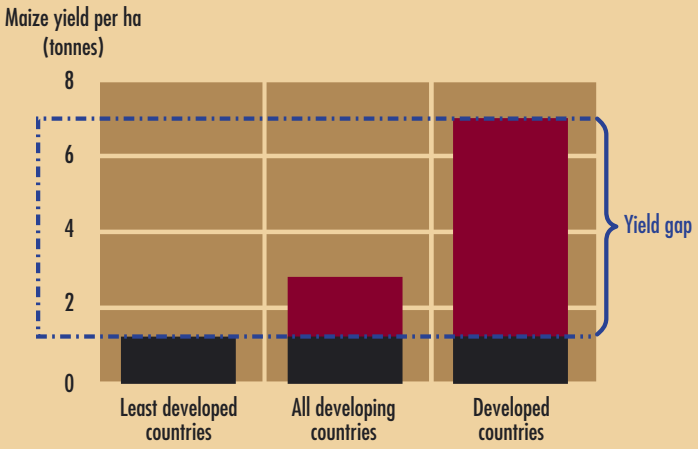
Adapted from *IAASTD Synthesis Report*

Key finding: Projections based on a continuation of current policies and practices indicate that global demographic changes and changing patterns of income distribution over the next 50 years will lead to different patterns of food consumption and increased demand for food. Global cereal demand is projected to increase by 75% between 2000 and 2050 and global meat demand is expected to double. More than three-fourths of growth in demand in both cereals and meat is projected to be in developing countries. **(# 5)**

Interventions to modify dietary preferences, the increasing costs or declining availability of fossil fuels and water, or technology-led shifts to manufactured meat protein, could change these outlooks. Public-private partnerships and policy support for local food systems would encourage such transitions.

The 'yield gap'

An important consequence of environmental degradation and poverty is the 'yield gap' – the difference between potential and actual yield.
It is often the result of land clearance, depleted soil health and fertility, and limited institutional investment in supporting and sharing locally-appropriate innovations and developing participatory place-based agroecological research, extension and education.



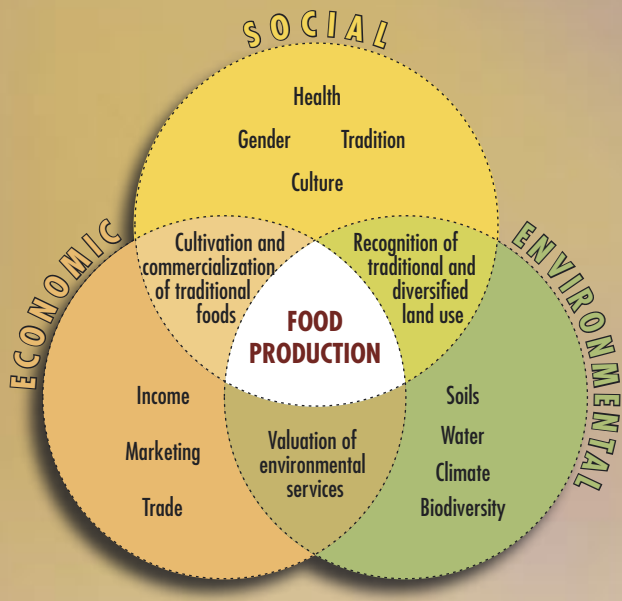
Source: FAO. Statistics 2000

In this context, how will it be possible to reduce poverty and maintain and enhance environmental and cultural services while increasing sustainable productivity and diversity of agricultural production?

Multi-functional agriculture integrating social, economic and environmental aspects

Key finding: Agriculture operates within complex social, economic and environmental systems and so should be seen as multifunctional in its nature. A multifunctional approach to AKST will enhance impact on the alleviation of hunger and poverty, and improve human nutrition and livelihoods in an equitable and sustainable manner. **(# 6)**

THE INESCAPABLE INTERCONNECTEDNESS OF AGRICULTURE'S DIFFERENT ROLES AND FUNCTIONS



Design: UNEP/GRID-Arendal, Ketill Berger

Key finding: An increase and strengthening of AKST towards greater adoption of agroecological sciences will contribute to addressing environmental issues while maintaining and increasing productivity. **(# 7)**

Agroecological sciences provide an interdisciplinary framework that integrates biophysical, ecological and social sciences in the study of processes and relationships among species interacting through an agricultural system and its environment.

Farm technologies and practices can weaken the resilience and functioning of the living systems on which agriculture depends or can be designed to strengthen the provision of agroecosystem goods and services, including food, clean water, soil health and crop protection.

Key finding: Significant pro-poor progress requires creating opportunities for innovation and entrepreneurship which explicitly target resource-poor farmers and rural labourers. **(# 13)**

Way forward

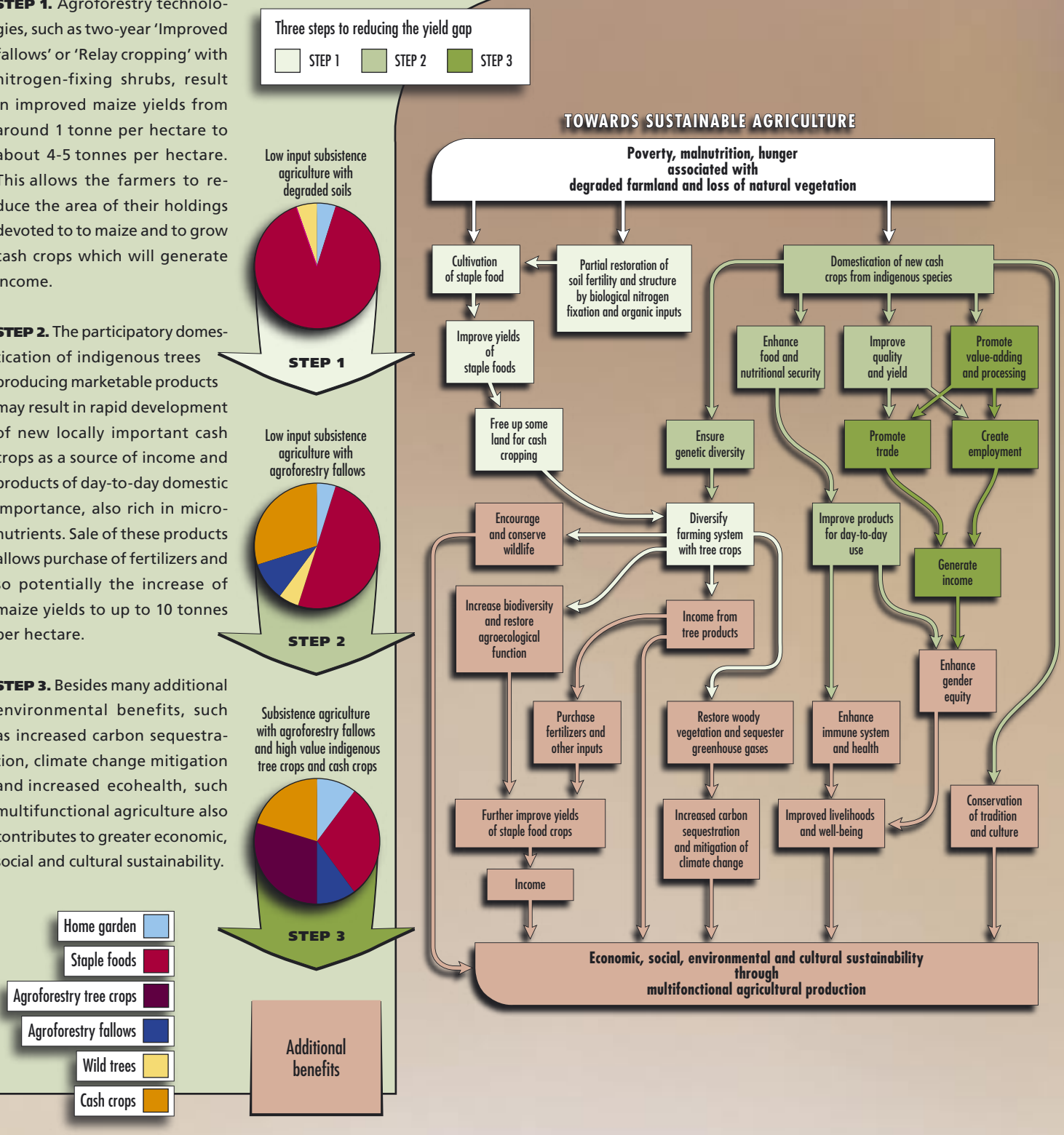
Addressing the yield gap through agroforestry practices

As an example of a pro-poor approach, by integrating trees into farmland, agroforestry practices contribute to filling the yield gap. Productive agroforestry systems can improve soil fertility, increase biological and landscape level diversity, and include diversification into perennial cash crops that meet social and market needs thus contributing to social sustainability.

STEP 1. Agroforestry technologies, such as two-year 'Improved fallows' or 'Relay cropping' with nitrogen-fixing shrubs, result in improved maize yields from around 1 tonne per hectare to about 4-5 tonnes per hectare. This allows the farmers to reduce the area of their holdings devoted to to maize and to grow cash crops which will generate income.

STEP 2. The participatory domestication of indigenous trees producing marketable products may result in rapid development of new locally important cash crops as a source of income and products of day-to-day domestic importance, also rich in micronutrients. Sale of these products allows purchase of fertilizers and so potentially the increase of maize yields to up to 10 tonnes per hectare.

STEP 3. Besides many additional environmental benefits, such as increased carbon sequestration, climate change mitigation and increased ecohealth, such multifunctional agriculture also contributes to greater economic, social and cultural sustainability.



Innovation in knowledge, science and technology

Key finding: Strengthening and redirecting the generation and delivery of AKST will contribute to addressing a range of persistent socioeconomic inequities.
The choice of relevant approaches to adoption and implementation of agricultural innovation is crucial for achieving development and sustainability goals. **(# 8, 19)**

Technology should meet the community's needs without making local agriculture less sustainable. To make gains based on technology, it is necessary to provide sufficient resources to integrate biotechnologies such as agroecological methods and advances in breeding, through farmer participation and extension services.

Efforts can be prioritized in those regions where the poorest are concentrated and where local and regional disparities in food production, distribution and access are severe.

Key finding : Many of the challenges facing agriculture currently and in the future will require more innovative and integrated applications of existing knowledge, science and technology (formal, traditional and community-based). **(# 10)**

Innovation is a multi-source process involving a mix of stakeholders, organizations and types of knowledge systems. Innovative combinations of technology and knowledge generated by past and present institutional arrangements and actors will lead to more sustainable pro-poor agriculture and resource management practices.

Key finding: Innovative institutional arrangements are essential to the successful design and adoption of ecologically and socially sustainable agricultural systems. **(# 16)**

Few existing problems in agriculture are solely caused by a lack or failure of science and technology, but instead derive from social, economic or legal frameworks.

It is therefore critical to define first what problems are best solved by changing social, economic or legal frameworks and second those which are best solved using technology.

Options for action include:

1. **Enhancement of private and public research and development efforts on the 'food of the poorest', i.e. crops such as cassava, millet, sorghum, potatoes and underutilized and neglected crops.** This would encourage knowledge innovations in new directions (e.g. organic agriculture, integrated pest management, precision farming, local innovations in crop management and agricultural biodiversity conservation).

2. **Combination of endogenous and exogenous knowledge** including different local (farmers, marginalized and poor actors, traders, craftsmen, etc.) and external actor groups (civil servants, researchers, service providers, etc.) to build new learning communities. It is essential to pay due attention to overcoming race, ethnic and gender biases that hamper the participation of marginalized communities, diverse ethnic groups and women.

3. **Support of participatory and experiential learning processes and multi-organizational partnerships, integrating formal and informal AKST.** Additional options are needed to extend these processes to marginalized peoples and areas in ways that respect and uphold their roles, rights, and practices.

4. **Development of partnerships in agricultural and social science research and education** would offer potential to advance public interest in science and increase its relevance to development goals.

5. **Involvement of organizations of small-scale farmers in the governance of research stations** would strengthen pro-poor decision-making. The collaboration of stakeholders along value chains in AKST decision-making similarly helps orient effort toward solving problems in the development of opportunities along the whole chain.

6. **Change in the established practices of research and extension organizations based on a 'transfer of technology' approach.** Greater attention must be given to local natural, social, economic and human conditions of production, taking into account not only the individual crop productivity, but the agroecosystem and how this is integrated in the local economy, where often the family carries out complementary activities.

7. **Development of new organizational practices, referred to as 'local agriculture'** (farmers' markets, community-supported agriculture, community gardens, etc.). Such practices devote greater attention to the social, economic, cultural and environmental sustainability of the whole food system.

8. **Investment in rural education** complemented by extension and advisory services. Farmers' field schools and research circles, participatory plant breeding, social forestry, study clubs and community interaction with school-based curriculum development should be encouraged and supported.

Policy options for sustainable agriculture

Policy framework	Options	Benefits
Public policy, regulatory frameworks and international agreements are critical to developing and applying sustainable agricultural technologies and practices.		
Trade policy	Transition towards differentiated policies for food and commodity trade, including: ■ non-reciprocal access and special treatment; ■ reduced barriers and elimination of escalating tariffs for processed commodities in developed and developing countries.	Opportunity: ■ for developed countries – to manage price volatility; ■ for developing countries – deeper generalized preferential access to developed country markets for commodities of importance to rural livelihoods; and increased public investment in local value addition.
Food retail	Establishment of appropriate institutions for procurement, food trade and retail markets that direct opportunities and benefits to small-scale and local traders and retailers, and that support resource-conserving production methods.	Small-scale producers benefit from rising demand for quality food from the emerging urban middle classes in developing countries.
Regulation policy	Effective implementation of international agreements on the registration, trade and reduction in the use of toxic chemicals, and regulations and incentive programmes that stimulate wider adoption of good practice standards (e.g. integrated crop and pest management and agroecological practices).	Major advances in the achievement of sustainable, equitable, productive food and farming systems.
More and better targeted AKST investments by both public and private sectors, explicitly taking into account the multifunctionality of agriculture, can help advance development and sustainability goals.		
Public investments	■ Targeted programmes assisting small-scale producers to adjust to increasing rainfall variability, higher intensity rainfall events and rising temperatures and contribute to climate change mitigation. ■ Support to investments in the basic development of rural areas, creation of institutions for value-adding in agriculture and food systems that distribute benefits fairly and equitably along the chain. ■ Development of local and national capacity in agroecological research, extension and education. ■ Development of new collective security mechanisms for food stock management at local, national, regional and international levels.	Shift of public and private AKST towards choices that combine productivity and protection of public health, natural resources and ecosystems, and that return a greater proportion of the profits from food and farming industries to small-scale and rural labourers.
Supporting actions are needed in the areas of intellectual property rights and transparent, full-cost pricing.		
Intellectual property rights	Provision of strong incentives to work with the crops that are crucial to poor farmers' livelihoods while protecting farmers' and communities' rights to domesticate, develop and trade their own genetic materials.	Increased diversity of crops and seed providers with capacities and rights to innovate maintained locally. This leads to improved nutrition, security and resilience to environmental stresses and climate change. Traditional knowledge and the work of indigenous communities are valued in reducing poverty.
Transparent full-cost pricing	Developing and applying full-cost accounting standards that include externalities and spill-overs from food and farming systems.	Allowing for meaningful comparison of system performance and reducing exposure to catastrophic systemic risk.

More information

This Policy Brief draws on the findings of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), carried out from 2005 – 2007 by over 400 authors from countries around the world.

The IAASTD was launched as an intergovernmental process, with a multi-stakeholder Bureau, under the co-sponsorship of the FAO, GEF, UNDP, UNEP, UNESCO, the World Bank and WHO.

Useful links

International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD): http: //www.agassessment.org
United Nations Educational, Scientific and Cultural Organization (UNESCO): http://www.unesco.org
Scientific Committee on Problems of the Environment (SCOPE): http: //www.icsu-scope.org
United Nations Environment Programme (UNEP): http: //www.unep.org

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