IAASTD

International Assessment of Agricultural Knowledge, Science and Technology for Development

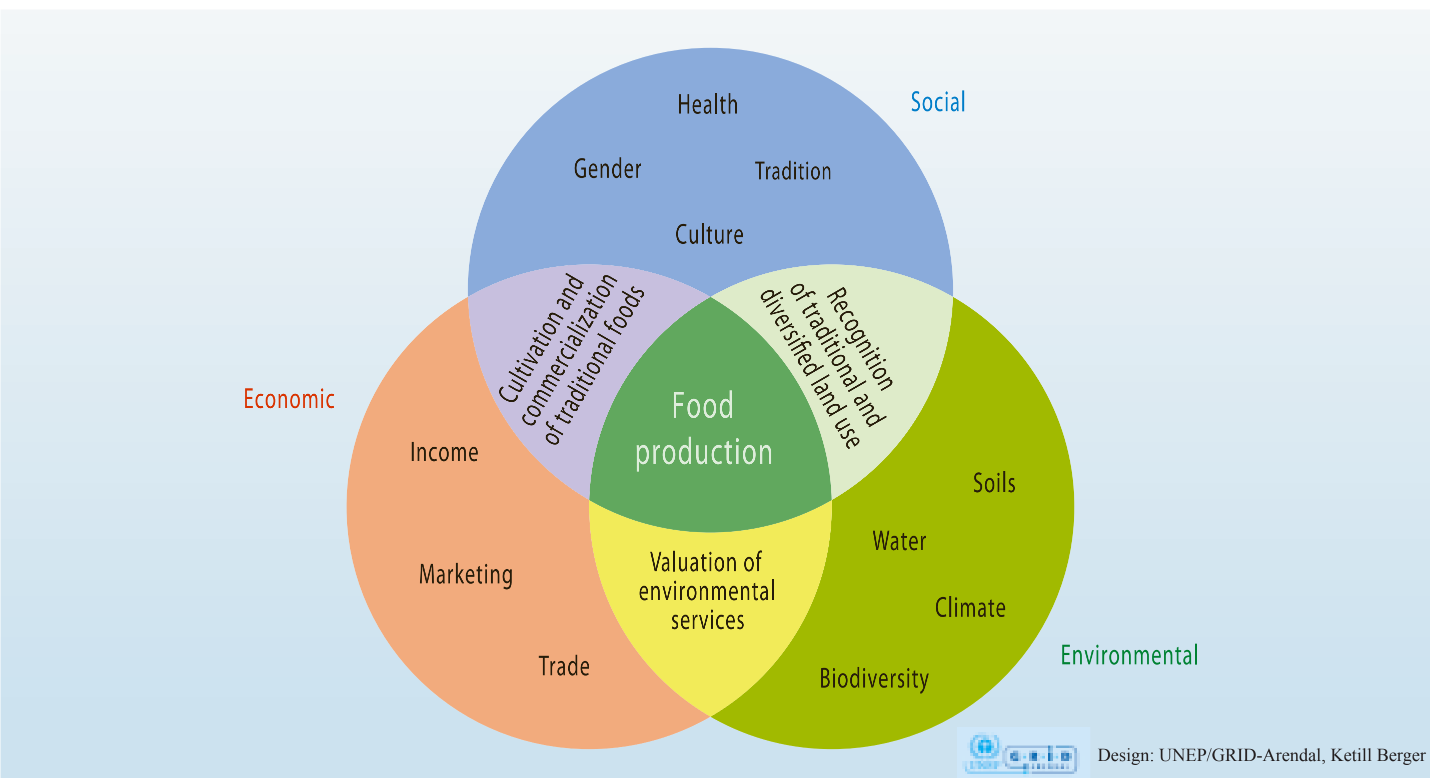
Issues in Brief

Towards Multifunctional Agriculture for Social, Environmental and Economic Sustainability

Agriculture operates within complex systems and is multifunctional in its nature. A multifunctional approach to implementing agricultural knowledge, science and technology (AKST) will enhance its impact on hunger and poverty, improving human nutrition and livelihoods in an equitable, environmentally, socially and economically sustainable manner. Multifunctionality recognizes the inescapable interconnectedness of agriculture's different roles and functions, i.e., agriculture is a multi-output activity producing not only commodities, but also non-commodity outputs such as environmental services, landscape amenities and cultural heritages.

Over the last 60 years, intensive production practices of high-yielding staple food crops were promoted, often on land cleared of much of its natural vegetation. To be productive for more than a few years, these crops require inputs of fertilizers, pesticides and often irrigation. In high-input agricultural systems, fertilizer and pesticide use is often excessive and environmentally damaging. In many parts of the world, small-scale farmers do not have sufficient access to state-of-the-art technologies, inputs, knowledge and innovations that enhance productivity while protecting health and the environment.

Thus, increased attention needs to be directed towards new and successful existing approaches to maintain and restore soil fertility and to maintain sustainable production through practices such as low-input resource-conserving technologies based on in-



The inescapable interconnectedness of agriculture's different roles and functions.

tegrated management systems and an understanding of agroecology and soil science (e.g., agroforestry, conservation agriculture, organic agriculture and permaculture). These technologies minimize the need for high levels of inputs and are socially appropriate approaches to small-scale agriculture.

Where are we in terms of meeting sustainable development goals?

Globally, agricultural food production has been growing at about 2% per year since 1960, with higher rates of growth in developed countries. Area productivity, particularly in sub-Saharan Africa and Latin America, is still much lower than in industrialized countries and in Asia.

Increased food production has contributed to improved human health and nutrition. At the turn of the millennium, the world produced sufficient food calories to feed everyone -- the dietary energy supply for the global population was estimated to be 2803 kcal per person per day, comfortably within the range of energy intake considered adequate for healthy living. Yet approximately 850 million people are unable to obtain enough food to lead healthy and productive lives.

Increased production has contributed to improved livelihoods for some of the 2.6 billion people – men, women and children – who rely on farming, livestock production, forestry or fishery. But more than half of the people living in extreme poverty depend on the agricultural sector for their livelihoods.

Farmers can enhance natural resources through sustainable soil management practices, promotion of agrobiodiversity and agroforestry. However, in many parts of the world, agricultural practices have resulted in the degradation of land, water and natural ecosystems.

Approximately 1.5 billion people are directly affected by land degradation; deforestation is proceeding at 13 million ha per year; over half of the world's grasslands are degraded; depletion of marine resources is so severe that some commercial fish species are now threatened globally; the demand for water for agriculture has led to serious depletion of surface water resources; and half of the world's wetlands are estimated to have been lost during the last century.

Enabling multifunctionality

Securing the social, environmental and economic functions of agriculture requires policies and investments at multiple levels:

Social functionality

- Empower marginalized stakeholders to sustain the diversity of agriculture and food systems, including their cultural dimensions.
- Educate and train policymakers and public agency personnel in decentralized participatory planning and decision-making, and in understanding and working effectively with rural communities.
- Invest in enriching training and education for farmers and other rural actors in order to facilitate their engagement in locally directed development processes.
- Invest in modern information and communications technologies (ICTs) to open up potentially powerful opportunities for extending the reach and scope of educational and interactive learning.
- Give women access, ownership and control of economic and natural resources through legal measures and appropriate credit schemes.

Mixed cropping for multiple benefits. Source: Roger Leakey

- Support the development of women's income generating activities and reinforce women's organizations and networks.

Environmental functionality

- Provide safe water and encourage efficient water use practices.
- Decrease greenhouse gas emissions.
- Minimize the adverse impacts of climate change through integrating new and improved crop varieties and livestock breeds into diversified, resilient, risk-averse farming systems.
- Maintain and enhance environmental and cultural services through support of agroecologically sound practices.

Economic functionality

- Promote market and trade policies that benefit small-scale producers by leveling the playing field and increasing opportunities for value addition. Reverse the export focus that has left small-scale producers, the majority of the rural poor, more vulnerable to international market factors.
- Increase access to financial services and products, such as savings services and crop or rain insurance. These instruments are critical to building assets and reducing the risk associated with adopting new technology, transitioning to sustainable agricultural practices, and innovating production and marketing methods
- Use microfinance to allow small-scale producers to expand production, buy fertilizer and other inputs and technologies, and to diminish seasonal fluctuations in income.

Some practices that can facilitate a multifunctional approach

Integrated functionality

An example of an integrated approach would be addressing the large difference between maize yield achieved by very poor farmers and the potential yield of the crop, mainly due to soil infertility and poor access to agricultural inputs through: 1) use of improved fallows to rehabilitate degraded farmland and increase maize yields 1-4 tonnes per hectare by

Polyculture contributes to conservation and biodiversity. Source: Food First.

using N-fixing legumes; 2) diversify into indigenous fruit/nut crops to generate income and to improve nutrition and health; additional income can be used to purchase fertilizers to give yield increases of 4-8 tonnes per hectare; and 3) process, add value and trade indigenous fruit/nut products to expand income and create employment.

Agroecology

Agroecology, considered the foundation of sustainable agriculture, is the science and practice of applying ecological concepts and principles to the study, design and management of sustainable agroecosystems. An agroecological approach recognizes the multifunctional dimensions of agriculture and facilitates progress toward a broad range of equitable and sustainable development goals. A wide variety of technologies, practices and innovations including local and traditional knowledge draw on the science of agroecology, including integrated natural resource management (INRM), organic agriculture, and others described below.

Integrated natural resource management

INRM approaches are options to consider when choosing a productive agriculture to meet sustainability and development goals. Some of these are mentioned briefly below; more details can be found in the IAASTD reports. In any approach, it is important to keep in mind that:

- INRM often requires participatory approaches to planning and implementation; this is true of land use as well as water management.
- Good husbandry is needed to support agroecosystem health and enable yield to reach physiological potential.

INRM practices are based on the addition of ecological principles to more widely recognized areas of agronomy, livestock husbandry and natural resources management. For example, Integrated Pest Management (IPM) takes many forms, but in general emphasizes cultural and biological controls and selective application of chemicals where necessary that do not harm human health, biodiversity or populations of pest predators, parasitoids and other beneficial organisms. IPM is based on an understanding of agroecosystems as complex webs of interacting species that can be influenced to achieve crop protection.

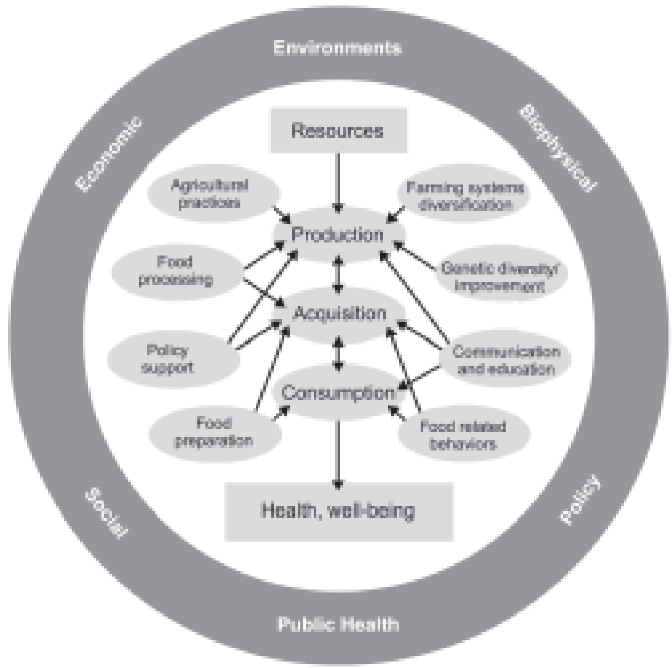
Organic Agriculture

Organic agriculture (OA) includes both certified and uncertified production systems and encompasses practices that promote environmental quality and ecosystem functionality. Organic systems are knowledge-intensive and based on replacing the use of synthetic inputs with ecologically based approaches to soil fertility and pest management. Benefits include lower levels of pesticides in food products and less pesticide and nutrient pollution in waterways and groundwater.

The basic principle of OA is to enhance soil organic matter and soil structure through the supply of macro and micronutrients from animal and green manure (compost/mulch), nitrogen-fixing legumes, enhanced cation exchange capacity and nutrient retention. In 2006, organic production encompassed 31 million ha, about 2% of cultivated land, on more than 600,000 farms in approximately 120 countries. With organic global sales now approaching US$40 billion, certified organic agriculture (COA) offers a challenging, but attractive rural development pathway for policy makers wishing to support the production of global public goods. OA can help expand a growing alternative global market that extends economic opportunity to small-scale producers and improves agricultural performance through better access to food and relevant technologies, as well as environmental quality and social equity.

Conservation Agriculture

Reduced tillage and conservation agriculture (currently practiced on 5% of cultivated land, hence about 95 million ha) are low-cost systems that have been widely adopted in the last 25 years in North and South America, with current expansion in South Asia. Some of the benefits of conservation agriculture include reduced wind and water erosion, increased water use efficiency and water infiltration, and enhanced conservation of soil organic matter. Negative aspects include increased greenhouse gas emissions (N_2O, CH_4) due to higher denitrification rates, increased vulnerability to pests and diseases, and, in some systems, increased need for herbicides. The resilience of conservation farming systems in the Central American highlands to recent El Niño droughts and to the catastrophic soil losses from Hurricane Mitch provide strong evidence of conservation agriculture's potential as an adaptation



Holisitic food system model. Source: Combs et al., 1996 response to increased rainfall variability and storm intensity with climate change. Soil-specific research is needed to enhance applicability of no-till farming by alleviating biophysical, economic, social and cultural constraints.

Agroforestry

Agroforestry is a dynamic, ecologically based natural resource management system that through the integration of trees into agricultural landscapes, diversifies and increases production, while simultaneously promoting social, economic and environmental benefits for land users – this approach is very similar to the concept of multifunctional agriculture.

As with the systems described above, agroforestry rehabilitates degraded land; increases above- and below-ground biodiversity, increases C sequestration, and protects soils and watersheds. In addition, agroforestry provides three additional outputs: (1) useful and marketable tree products for income generation, fuel, food and nutritional security/health and the enhancement of local livelihoods; (2) complex mature and functioning agroecosystems akin to natural woodlands and forests; and (3) linkages with culture through the food and other products of traditional importance to local people. In some cases, trees can be competitive with crops; although, it is important to recognize that benefits can be slow to materialize due to the longevity of trees.

Agroforestry is practiced by over 1.2 billion people, and the tree products are important for the livelihoods of millions more, e.g., in the urban areas of developing countries. Many of the benefits from agroforestry products arise from local marketing. Some of the indigenous tree species are currently used in participatory domestication programs bringing together formal AKST with traditional and local knowledge.

Typically farmers in developing countries, who do not have access to other sources of income or social support, still have to provide food, medicines and all their other day-to-day needs from their natural resources. But now, as a result of deforestation and modern farming systems, local communities do not have access to all the species that used to provide the products needed for everyday survival. There is growing evidence that agroforestry can help these farmers become self-sufficient and support their families.

Policy options for advancing agroecological practices

- Advance national policies and legal frameworks to provide incentives for agroecological production, including the adoption of IPM and

Cocoa under Cordia alliodora in Costa Rica. Source: Roger Leakey.

  the transition to organic production. This may include the adoption of a national definition of agroecological production and a high-level policy statement in support of measures to facilitate the transition to agroecological production.
- Strengthen promotion and marketing of national agroecological products and establish agroecological, IPM and organic certification programs for the national and international market.
- Facilitate increased professional education on agroecological production, especially through agronomy programs at national university systems and increased scientific investigation.
- Increase the number of agricultural extension agents who are trained in agroecological pro-

duction, including IPM and organic production.

- Provide crop insurance for farmers transitioning to agroecological production, including transitions to IPM and organic production.
- Create special credit lines for small- and medium-scale agroecological producers, and provide tax exemptions on inputs for agroecological and organic production.
- Provide payments and rewards for ecosystem services and provide incentives for the production of agroecological products, such as biological control inputs.

Challenges for AKST

Under conditions of changing climate and economic uncertainty, it will be important to include sciences outside the conventional agricultural domain and to draw interests, such as water management authorities and biodiversity conservation agencies, into the generation of AKST. Using local and traditional knowledge as well as advanced sciences across a broad field of disciplines can facilitate multifunctional approaches to agriculture that benefit small-scale producers.

Current assessments indicate that new research investments could improve multifunctional performance significantly and rapidly in all parts of the world. This requires that (1) existing systems of multifunctional merit be upscaled and their underlying principles brought into mainstream practice; (2) empirically tested designs for new approaches and systems be more widely promoted in small-scale and industrial systems; (3) data and information be available in key areas of concern; and (4) policies and institutions that facilitate multifunctional agriculture be strengthened.

The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) provides information on how agricultural knowledge, science and technology can be used to reduce hunger and poverty, improve rural livelihoods and human health, and facilitate equitable environmentally, socially and economically sustainable development. The full set of IAASTD reports includes a Global and five sub-Global reports and their respective summaries for Decision Makers as well as a Synthesis Report, including an Executive Summary. The reports were accepted at an Intergovernmental Plenary in Johannesburg in April 2008.

The assessment was sponsored by the United Nations, the World Bank and the Global Environment Facility (GEF). Five UN agencies were involved: the Food and Agriculture Organization (FAO), the UN Development Program (UNDP), the UN Environment Programme (UNEP), the UN Educational, Scientific and Cultural Organization (UNESCO) and the World Health Organization (WHO).

IAASTD Issues in Brief are taken directly from the IAASTD Reports published in 2008 by Island Press.

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