Agricultural Innovation for Food Security and Poverty Reduction in the 21st Century: Issues for Africa and the World

Issues Paper for *State of the World 2011: Innovations that Nourish the Planet*

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1. Introduction

Food security is rising to the center of global discourse and has become an issue of national policy as well as public concern. The 2007 food price crisis, which is projected to be repeated in 2010, led to food riots, a re-assessment of national food security strategies, and a race to procure food supplies overseas. Meanwhile, the worldwide financial crisis has sharply reversed trends of declining numbers of hungry people: after dropping for much of the last decade, the ranks of the hungry rose again in 2009, to over 1 billion. Roughly half of these are smallholder farmers, 22 percent are rural landless, 20 percent are the urban poor, and 8 percent are populations that depend mainly on natural resources, such as fishers, herders, and forest dwellers.

Historically, agricultural development played a central role as a driver of rural poverty reduction. However, recent trends of slowing agricultural productivity growth and the marginalization of poor farmers as markets evolve have challenged conventional strategies for achieving poverty reduction—including government committments through the United Nations Millennium Development Goals. Complicating the food and nutrition policy response is the simultaneous epidemic of obesity in both developed countries and urban populations in developing countries.

Many voices are questioning whether and how the world can feed 9 billion people in 2050. Projected increases in food demand of 50–100 percent assume that there will be continued rapid increases in the demand for livestock products. In Africa, agricultural demand is expected to triple by 2050. Worldwide, incipient action to mitigate climate change has prompted the conversion of large areas of agricultural land to biofuels, placing further pressure on food prices and sparking furious debate about global land use.

The newest projections of the impacts of climate change, meanwhile, suggest quite dramatic negative impacts on crop yields in much of the developing world as a result of temperature and rainfall changes, as well as the potential collapse of major irrigated farming systems in Asia due to melting of glaciers that feed major river systems. The U.S. Department of Defense is evaluating food issues as a major scenario for future conflicts and wars.

Yet even without climate change, agricultural land degradation has reduced productivity on huge areas of land, so that even sustaining current production will require major investments to restore soils and grazing lands. Crop and livestock production are now the ecologically dominant land use on 70–80 percent of the land area inhabitable by humans; thus, the provision of ecosystem services more generally—watershed protection, habitat for biodiversity, pollination, and pest and disease control—has become centrally dependent on how today's agricultural working lands and associated conservation areas are managed. The management of agriculture and ecosystem services cannot be separated.

These daunting challenges have led to much "doom-and-gloom." But at the same time, these pressures have mobilized remarkable innovation around the globe, from farmers' fields and national policies, to private agribusiness and food industry, NGOs and farmer organizations, government agencies, and the research community. These innovations have been driven by very different paradigms, ideologies, and visions for a future food-secure world.

Due in part to sharp conflicts among these perspectives, it has been difficult to mobilize concerted action, and it has been difficult politically for leaders to define policy and finance investment in agriculture at the scale that is clearly needed. Conflicts range from disputes over the form that tenure security should take (e.g., land consolidation to create commercially viable farming entities versus protection of universal land access), to choice of technology (e.g., organic based on locally available inputs versus GMOs purchased from multinationals), to climate mitigation (e.g., subsidies targeted at large commercial farmers to reduce high emissions versus those targeted at smallholders to sequester carbon in soils and vegetation).

The Worldwatch Institute's *State of the World 2011* (SOW11) report, "Innovations that Nourish the Planet," seeks to highlight innovations that can address the pressing agricultural challenges facing the world. These include innovations that will reduce hunger, improve environmental and agricultural sustainability, improve the lives of women and girls, and be scalable and economically feasible for both farmers and the donor/investment community.

Worldwatch hopes this report will:

- Encourage increased investment in agriculture from donor agencies, governments, private investors, and new potential donor communities;
- Increase awareness about how investing in agriculture is the single most effective way of reducing hunger and poverty around the world;
- Encourage policymakers, agribusiness, farmers, and donors to include environmental sustainability criteria in their decision-making and lending practices; and
- Bring greater exposure to effective projects and innovations that currently enjoy little exposure, generating a wider audience for consideration.

The purpose of this issues paper is to provide an overview of the issues, numbers, disputes, and approaches so that contributors to SOW11 can share a common framework and consider how the innovations they describe fit into the larger international discourse.

The paper is structured as follows:

- **Section 2** describes diverse perspectives on food security that emphasize global supply chains to feed middle-class populations in cities; smallholder farmers who still supply much of the world; and smallholder farmers who are relatively disengaged in commercial markets.
- **Section 3** discusses the "landscape" of agricultural innovations and lays out three major challenges for SOW11 authors to evaluate.
- **Sections 4, 5, and 6** describe these challenges in greater detail: working around the conflicting policy perspectives on the causes and solutions to hunger and global food security; integrating the food security agenda with the climate and ecosystem restoration agendas; and empowering farmers and communities at risk of food insecurity and hunger.
- **Section 7** proposes some key questions and approaches that SOW11 authors may want to consider to address these challenges.
- **Annex I** (see separate document) presents some basic facts about hunger and food insecurity, agricultural production patterns, and the environmental threats and impacts of agriculture that can help put the issues in context.

2. Global Perspectives on Food Security and the Changing Role of Smallholders

Globally, the most powerful policy voices and actors—and those with the greatest private and public investment resources—are focused on strengthening food systems to secure the large-scale movement of safe food supplies at low and stable prices for vast populations of consumers, chiefly non-farmers in urban areas. International agribusiness and food trading companies dominate this sphere. These groups are concerned with "Global Food Security" (broadly defined) for the billions who do not currently access sufficient, adequate quality foods. They seek to mobilize large amounts of product to enter marketing streams for urban retail and wholesale products, and they seek to keep food prices low and widely distributed through low-unit-cost transport and marketing systems, to feed the world's cities and growing landless populations.

Nearly half the world's population is estimated to be fed by smallholder farmers today; however, new supply chains for supermarkets, large-scale food buyers, and international trade increasingly rely on large-scale producers to meet more demanding quality and health standards and ensure regular, large volumes of homogeneous product. Buyers for specialty fresh and processed products increasingly specify the variety and growing practices; thus, they tend to rely on larger-scale producers, strongly organized producer groups, or food industry outgrowers. Increasingly, supermarkets and others determine product choice and methods.

The overall share of food supplied by international imports is relatively low (typically about 10 percent, though it is higher in dry oil-rich countries of the Middle East and a few African countries) and is fairly stable over time. Yet agricultural trade markets play a disproportionate role in policy discussions. This is due to their role in stabilizing food supply and prices, and their importance in generating foreign exchange for sellers. A large share of international development assistance to agriculture has been for export development.

Unlike these large-scale, trade-oriented groups, a second community of interest groups and investors focuses on "Food Security for the Poor"—that is, how to ensure that individuals, households, and communities with low economic purchasing power (the 1 billion who are already at risk of hunger) will have year-round, adequate food supplies and quality. Given the disproportionate incidence of hunger in rural areas and among smallholder farmers, their concern is with feeding rural farming and pastoral communities and nearby small towns.

These groups show greater interest in diversified products (including grazed and wild-sourced) to ensure good nutrition; strengthening capacities of smallholder farmers to supply food; local distribution systems; production systems that do not depend as much on inputs that must be imported from outside the area; and special provision of such inputs. This community sees agricultural production and related processing and marketing as a central strategy for rural poverty reduction, and seeks to link these components strategically.

Public investment in agriculture from international donors and national governments, particularly in smallholder agriculture and food security, declined sharply during the 1980s and 90s. This period also witnessed strong growth in private sector agribusiness and food industry, with structural shifts in research to private crop breeding and agrichemical development, and

supermarket and international supply chains. The focus was on securing food supplies for growing middle class and urban populations.

The current resurgence of public interest in agriculture refers principally to smallholder agriculture, and to food-insecure smallholders. But the relationship with larger trends has been inadequately articulated.

3. Strategies and Innovations to Reduce Hunger and Achieve Food Security

A great deal of progress has been made in reducing hunger and increasing food insecurity over the past 50 years. But this has been uneven, and there are now more hungry people today than were even alive a century ago. There is remarkable similarity between the action agendas proposed in the new millennium and those proposed since the 1970s. The United Nations Millennium Development Goal (MDG) on Hunger, despite being called ambitious, aims to only halve the number of hungry people by 2020.

The MDG Task Force on Hunger has highlighted seven actions that can be taken at the national and state/district (community) levels:

National-Level Actions

1. Move from political commitment to action
2. Reform policies and create an enabling environment

Much has been learned about policies to reduce hunger and increase food insecurity, and there have been significant "innovations" in policy process and content. Examples include:

- Decentralization of many policies to the district level to enable locally tailored policies
- Systematic stakeholder consultations to determine policy priorities to facilitate regional smallholder agricultural market developments
- Civic mobilization to advocate for policy action
- Establishing a "right to food"
- Public-private partnerships to mobilize and finance food security initiatives

Community-Level Actions

3. **Increase the agricultural productivity of food-insecure farmers**
4. Improve nutrition for the chronically hungry and vulnerable
5. Reduce the vulnerability of the acutely hungry through productive safety nets
6. **Increase incomes and make markets work for the poor**
7. **Restore and conserve the natural resources essential for food security**

Non-agricultural interventions (4 & 5) are absolutely critical and include such initiatives as maternal and infant feeding centers, clean water to avoid diarrhea and disease, food-for-work programs, nutrition education, micronutrient supplementation, and food subsidies. But these will

not be addressed in the SOW11 report. Rather, *the report will focus on the three recommendations in the area of agricultural production and resource management* (3, 6 & 7), which are especially important for smallholder farmers, rural landless, and resource-dependent people.

Technical and institutional innovations over the years have included:

Smallholder Productivity (#3):
- Improved germplasm for an ever-broader group of crops, grasses, trees, etc.
- Improved soil management, with more effective fertilizers and organic management
- Development of agroforestry systems
- Improved water management, including rainwater harvesting at the field, farm, and landscape scales
- Farm diversification to supply micronutrients through gardens, fruit trees, domestication of wild foods and medicines
- Horticulture

Market Access (#6):
- Capacity-building for smallholder farmer groups to access and get higher value from markets and link to supply chains into exports and national systems
- Mobile phones and other electronic communications applied to agricultural markets
- New agricultural input distribution channels to facilitate smallholder access

Natural Resource Restoration and Access (#7):
- Micro-watershed development, practice, and organization
- Low-cost methods of land/resource health assessment for targeting interventions
- Tools to facilitate community-based natural resource management
- Rotational grazing management for rangeland restoration
- Zero-grazing, fallow banks, and fallow reserves
- Rainwater harvest at plot, field, and sub-catchment scales

<u>Guidance for Authors</u>

Authors of SOW11 will be expected to highlight the above innovations, assess the conditions under which they have and have not been successfully adopted/adapted (e.g., agroecological zones, farming systems, social organization, policy and market environments), and discuss what has been learned about bringing them to scale.

But it will also be critical for SOW11 authors to step beyond assessments of the experience with these innovations, and to consider some of the hard questions about whether the innovations we have "on the shelf" and in "local knowledge" are sufficient to address the big challenges for hunger and food security that are now emerging.

In particular, we would like authors to highlight three of these challenges, which are important globally as well as in Africa:

1. **Aligning innovations with the policy discourse.** The choice of policies typically reflects underlying "mental models" about how and why hunger and food insecurity happens, and how they can be overcome. These have been highly contentious, and sharp differences in policy positions have frequently paralyzed the political process. Thus, we may want to ask: How do these innovations relate to the policy paradigm under which they are implemented? There are numerous conflicting "hunger narratives" that suggest different directions and priorities for action. To what extent is the success of these innovations driven by, dependent upon, or undermined by the dominant national or international policy paradigms?

2. **Integrating the food security agenda with the agendas for climate action and ecosystem restoration**. The greatest driver of land use and management change in the coming decades will almost certainly be climate response. Agriculture and land use are not only major contributors to greenhouse gas emissions (31 percent) and especially vulnerable to climate change, but also the only near-term option for large-scale GHG sequestration. Are the innovations being highlighted in SOW11 appropriate in a world wrestling with climate change? If so, are they sufficient? If not, what needs to be re-thought?

3. **Empowering farmers and communities**. One profound shift over the past four decades in many developing countries has been democratization. This is reflected in national politics and culture, by legitimizing smallholder farmer and community organizations and their growing participation in program design and policy dialogue. It is also increasingly reflected in the culture of development agencies, which have begun to talk about smallholder farmers and low-income rural and urban communities as "actors," "decision-makers," and "stakeholders," rather than as "beneficiaries" or "targets." In considering agricultural innovations—both technical and institutional—to what extent are they consistent with, dependent on, or undermining "empowered" farmers and at-risk communities? How are "top-down" and "bottom-up" strategies effectively linked to achieve transformation at scale? To what extent can different policy strategies, and the juggernauts of climate action and global food market development, support or undermine empowerment?

These three issues will be addressed in the following sections.

4. Aligning Innovations with the Policy Discourse

Efforts to mobilize agricultural innovation around the world are powerfully influenced by the broader discourse in national policy and the international development and donor community. These different perspectives typically ignore key objectives of the others. For example, none of the main strategies for "multinational global food chain" or "national urban food security" has a serious component to ensure local food security or local democratic decision making. Meanwhile, eco-initiatives have so far emphasized the value chain of specific products rather than the protection of whole landscapes or ecosystems.

At the same time, the dominant "food sovereignty" and "local food security" strategies largely ignore the burgeoning demand for food from cities and overseas markets and the consequent need to move commodities in bulk. Environmental initiatives have worked to slow the expansion

of agriculture into high-biodiversity-value habitats. Some analysts have hopes that cultivating "super-crops" in very intensive, ecological-sacrifice zones can feed the projected 9 billion people in 2050, but that vision is fading with rising concern about freshwater aquatic biodiversity. Typically, these strategies have failed to look broadly at either rural or urban food security, and no "environmentally-friendly strategy for feeding 9 billion" has been articulated in any detail.

Meanwhile, the current discourse on the causes of hunger and food insecurity, and the strategies to address them. is highly contentious. It is often ideological (influenced by the broader narratives described above) and is usually determined by site experience. There are numerous hunger "narratives" both in Africa and worldwide: different groups have different explanations for the phenomena of widespread hunger and limited food supply. (See Table 1.) Some of these narratives emphasize low agricultural productivity, either from lack of agricultural inputs or from natural resource degradation. Others highlight agricultural market constraints, either limits to market activity for smallholders, or distorting impacts of external markets. Still others emphasize the disempowerment of farmers and communities.

Table 1. Drivers of Hunger: A Diverse Discourse

Driver	Cause	Proposed Response	Examples
Low agricultural productivity	*(a) Lack of agricultural inputs*	Improve farm inputs (seed, fertilizer, pesticide); technical investment; credit to purchase external inputs, typically specialization	"Green Revolution," "New Green Revolution," GMOs
	(b) Degradation of farm resources	Invest in sustainable and ecosystem-friendly land management practices; rehabilitate soils, watersheds, grazing lands, forests; water efficiency; diversify production; payment for ecosystem services (PES); credit for resource-improving investments; organic, regenerative, or conservation agriculture; diversify products and varieties; systems focus	Sustainable Land Management, "Evergreen Revolution," agroecology, agroforestry, organic agriculture
	(c) Ecosystem degradation	Generally includes (b) plus cross-sectoral integrated approaches like ecoagriculture landscapes, integrated watershed management, landscape agroforestry, biological corridors through agricultural landscapes, spatial planning and coordination	African Heartlands, Kenya Integrated Ecosystem Management Project. May address (e) through (i) depending on the site

	(d) Land unsuitable for farming	Emigration out of region; exit farming; zoning and regulation; seek off-farm jobs; use land for ecosystem services	May be caused by low productivity, high risks (e.g., floods or drought) or high value for ecosystem service; often no technical resources provided or allowed, or only low-input
Problems of market organization and access	*(e) Poor market infrastructure/ institutions*	Road and market infrastructure investment, more efficient value chains; link low-income producers to higher-value market chains, outgrower schemes, facilitate access to imported inputs and products, challenge monopolies and predatory intermediaries, open up trade, focus on selected products, production and processing technology led by commercial or agroindustrial buyer, input providers; improve and reduce costs of farm-to-city supply chains (refrigeration, wholesale systems, retail outlets in poor neighborhoods, street food vendors), diversify products and markets	Assumes weakly developed market supply chains for inputs and outputs, monopolies and predatory intermediaries, government constraints on trade
	(f) Over-reliance on imported inputs/ exports	Local food sovereignty, territorial development strategy, promote use of local inputs and prioritize local markets, local or regional self-sufficiency, organic agriculture, indigenous technologies, protection of local seed systems	Concern that terms of trade are set externally, with local investments and resources diverted to support export and import interests rather than local food security
Disempowered farmers and communities	*(g) Weak farmer capacities*	Strengthen farmer organizations; farmer training and empowerment; knowledge-sharing and innovation systems; small grants facilities	Weak capacities for organization, entrepreneurship, capital mobilization, access to technical options, market knowledge; may focus on (a) or (b)
	(h) Weak governance and farmer rights	Tenure reform; good governance; legal systems; small-farm focus in public investment; reform of ecosystem regulations; strengthening negotiation skills and providing platforms for negotiation with buyers/sellers	Particular focus on women, ethnic minorities

	(i) High insecurity	Strategies emphasize security interventions, support for refugees, resources for re-planting	Political insecurity, civil war, refugees, etc. make investment and even production difficult; large-scale destruction of crops, stealing of existing food

All of these explanations are true in some places and for some food-insecure groups in Africa—sometimes several. But the targeting of response is rarely systematic, and strategies implemented (particularly in Africa) are generally determined externally, not by farming communities or their political representatives. Thus, in assessing agricultural innovations, it is worth considering the extent to which they are specific (or not) to particular paradigms and strategies.

5. Integrating the Food Security, Climate Action, and Ecosystem Restoration Agendas

Complicating both policy and action is the fact that food production and rural incomes are no longer the sole objectives for agricultural land use. Many agricultural regions are critically important for the provision of ecosystem services as well—particularly watershed protection, biodiversity conservation, and climate regulation. Yet agriculture, in its current form and practices, is now recognized to be a major threat to ecosystems (Scherr and McNeely 2008). There are widespread efforts to slow the advance of the "agricultural frontier"—to minimize increased production in high-value biodiversity habitats or watersheds, and to reduce the release of agricultural inputs and pollution in high-input/high-yield systems (UNEP 2009; also see Cook 2009).

In Africa, the environmental dimensions are acute. A GIS-based analysis of four countries in East Africa that overlaid spatial data on farming systems, poverty, watershed function, biodiversity, and carbon sequestration and storage found that many of the sub-regions most important for agricultural production and livelihoods were also critically important for watersheds and habitats, and were important stores of carbon (Collette et al. 2008).

In the face of looming water shortages, and with crop and grazing land constituting a large and growing portion of critical watersheds, it is becoming a priority for lands under agricultural use to be managed in ways that enhance watershed function. This means the retention of riparian vegetation; the retention of other natural or planted vegetation to slow movement of water across fields and micro-watersheds; the maintanence of year-round vegetative cover to protect soils from erosion, and the maintenance of soil organic matter and physical structure to facilitate infiltration of rainfall. In the rainforests of the Congo Basin and Madagascar, the savannah woodlands of southern Africa, and many African coastal peri-urban zones, land conversion for agriculture is a major threat to globally and nationally important biodiversity resources.

Biomass energy, long important in traditional forms, is now being developed as a substitute for fossil fuels, largely in the form of ethanol and biodiesel for industry and transport. Biofuels are almost certainly going to play an increasing role in land use, but so far they have been managed essentially as another extractive industry, rather than as a strategic component of long-term sustainable land use.

Today, the only well-established technologies for large-scale reversal of greenhouse gas concentrations are the sequestration and storage of carbon in agricultural soils and in above- and below-ground vegetation (such as perennial grasses and tree crops) through the restoration of degraded watersheds, grazing lands, and farm and community forests (Scherr and Sthapit 2009). Investing in sequestration in Africa not only offers opportunities to attract large-scale carbon finance for sustainable agriculture and land management, but can generate significant co-benefits for local livelihoods and ecosystem resilience, and enhance capacity for adaptation to climate change.

Historically, there has been a major disconnect between policymakers who are concerned about "nourishing the world" (both generally and to reduce acute and chronic hunger) and newer voices seeking to mobilize action in the land use sector for ecosystem conservation and climate mitigation and adaptation. The various models for agricultural, food security, climate, and ecosystem conservation, and the policies to promote them, are in serious conflict, which threatens to cancel out progress on production, food security, climate, or environmental goals.

While some part of the conflict is due to disagreements over values, much is due to incomplete knowledge of the facts or the broader picture. Much is also due to the perception that sectoral conflicts are unavoidable, and that in a zero sum, trade-off scenario, one's own top priority (food supply, food security, ecosystem health, climate action) must take precedence.

Yet in the midst of all this conflict, a rapidly growing set of individuals and institutions has been exploring, defining, evaluating and testing diverse strategies and innovations for reconciling these objectives—for developing landscape mosaics that *increase agricultural production*, *ensure food security*, *mitigate climate change*, and *conserve other ecosystem services*.

Innovative leaders and thinkers are found in all of the schools of thought, promoting innovation within their broad communities. These include strategies to achieve cross-sectoral goals through innovations in agricultural production technologies and practices, conservation strategies, landscape planning, institutional arrangements, markets, and policies. Some of these are still in the research phase, but many others have been successfully scaling up and could be replicated or adapted elsewhere with the right policy support.

Examples of potential win-win-win-win solutions include:

- Strategies for climate change adaptation that not only enhance resilience and farmer adaptation capacity, but also achieve climate mitigation and protection of other ecosystem services;
- Tree crop development (cocoa in west Africa, tea in East Africa, etc.) through high-biodiversity, high-carbon agroforests, now working with tens of thousands of farmers;

- Concern by the food industry for sustainable sources of supply (e.g., Unilever, Mars);
- Rise of consumer and institutional interest in eco-certification of foods (e.g., RSPO, Starbucks);
- Information technology enabling decentralized knowledge-sharing, innovation systems, and local control over knowledge systems (Community Knowledge Service);
- Payments for ecosystem services that pursue biodiversity, livelihood, climate, production objectives (e.g., Agricultural Carbon Facility for Africa, Bio-Carbon Fund);
- Platforms for stakeholder planning and investment in multi-functional landscapes (e.g., TerrAfrica national platforms for Sustainable Land Management); $1 billion recently invested in sustainable land management programs in Africa that link agricultural productivity, food security, ecosystem services, and beginning climate change;
- Private sector R&D in eco-friendly inputs (e.g., Syngenta improved seed, short-lived pesticides, precision farm machinery);
- Agroforestry systems that integrate fruit trees for year-round nutrition and child nutrition, fuel, etc. with crops.;

Guidance for Authors

Authors of SOW11 might consider their set of agricultural innovations in terms of how well they fit into, and contribute to, strategies to achieve "win-win-win-win" solutions—that is, agricultural production and productivity/food security outcomes as well as climate adaptation/mitigation and ecosystem services, at the field, farm, and landscape scales.

6. Empowering Farmers and Communities

Over the last few decades, the international agricultural development community has come to recognize the value of local farmer knowledge, the value of community organization to accelerate innovation, and the importance of structuring investments and programs to explicitly engage socially and economically marginal groups. This evolution has accompanied political democratization in many countries, particularly at local and sub-regional levels where organized farmers can have influence. Community organization has been instrumental in promoting innovation in marginal areas and in urban agriculture, in part because formal research and extension systems are rarely present.

But these insights have largely not translated into major structural changes in public, civic, or private programs. Top-down planning and design is still the norm, and donors still require detailed project plans upfront, before funds are released that would enable meaningful community input into design. Most funders distribute resources to governments or large NGOs rather than to farmer or community groups directly, and there is little funding for long-term engagement between farmers and agricultural scientists. While there are exciting, successful examples of community-led development at a large scale in areas like infrastructure, management of communal resources, and running child and maternal nutrition programs, they are less widely found in agriculture.

This challenge is particularly acute in two areas: empowering farmers to be leading actors in agricultural innovation systems and processes, and empowering women to fully engage and access such systems and processes.

Farmers as Leading Actors in Agricultural Innovation

With the resurgence of government and donor interest in agriculture, there is much talk of investment in research and extension systems, since the need for technical and market information is so critical. But the experience with extension has been mixed. It has worked best when focused narrowly on a set of commercial crops, and less well when applied in mixed, semi-subsistence farming systems—particularly ones that are unable to afford a high level of purchased inputs (which are typically the focus of extension programs, and even more so of private programs).

Agroecosystems in Africa and much of the developing world are highly heterogeneous, both ecologically and culturally. It is simply unfeasible that a "central source" theory of innovation will be able to provide the scope of innovations required, in the context of dynamic market and social environments. Agricultural science must necessarily prioritize research that will take years to complete, by experts who are paid far more than their client farmers. The rest of the innovation process is in the hand of farmers and communities.

NGOs have facilitated capacity-building for farmers in agricultural innovation, with particular success in economically and ecologically marginal communities (see, for example, World Neighbors and OXFAM). Numerous effective community knowledge-sharing mechanisms have developed, from cross-visits to video documentation to farmer monitoring networks (see Scherr et al. 2008). But there has been little systematic support for these farmer-led knowledge-generation-and-sharing systems, especially for food-insecure farmers. Formal systems are not linked to these informal systems. And the latter are poorly linked to formal research and extension programs, although they should be quite complementary. In addition, there are minimal financial resources through loans or grants available to support farmer testing and adaptation of innovations.

As the challenges of agricultural innovation move beyond individual, plot-specific challenges to landscape-scale challenges for co-managing agricultural development with ecosystem services, this requires social learning. Such social learning involves generating new insight and knowledge with diverse social actors, as well as negotiating the development of knowledge processes and products that foster common understandings and lead to concerted action (Roling and Wagemaker 1998; Buck et al. 2001).

A landscape-based innovation system plays an important role when:

- Problem-solving and meaningful behavior change depend on group action because changes in individual behavior are relatively inconsequential, as in watershed management;
- Concerted action is needed by farmer organizations, clubs, user groups, management associations, and the like;
- Local ownership of solutions across different groups of actors is essential to ensure ongoing participation and cooperation;

- Adaptation is important because management options are knowledge-intensive, and solutions are unclear or unacceptable to some who are affected; and
- Understanding of complex systems is needed to decide on strategic objectives, management strategies, and action (Buck and Scherr 2009).

Empowering Women

The poor, and especially poor women, are the populations most affected by environmental degradation, food insecurity, and climate change. But women can also be particularly effective environmental managers, in a way that reflects their nuanced community role. Women hold key responsibilities in traditional farming systems, as well as being household caretakers and the holders of rich indigenous knowledge, so they often see natural resources as indispensable to their livelihoods, families, and community.

Yet women are often seen as "invisible" managers—as subsistence farmers engaged in food production who are working inside land reform laws and programs that have transferred land to an almost exclusivly male individualized tenure system. In other words, women do the work but men make the decisions. Furthermore, women's participation in the labor force tends to be fluid, seasonal, and varied—and in a world where economic value is computed in monetary terms alone, women may be viewed as unproductive (FAO 2001).

To be fully effective, development, food security, and climate change adaptation programs must be gender responsive. Programs must be tailored to recognize the traditional roles that men and women play in the community. Gender responsiveness means asking important questions such as: How does each type of person spend money? What will they do in times of distress? How have roles changed? To what degree can men and women work together? Who has what concerns? What are the different learning styles?

There are many examples of how gender-role knowledge informs the strategies we take to confront food security issues. Women's role as communicators and their natural propensity to form supportive groups may be utilized effectively to spread the word about population-health-environment projects (D'Agnes et al. 2009; FAO 2001).

There are also more direct links between women and innovation. Home gardens are often used as experimental plots where women adapt or diversify wild and indigenous species, often rescued from neighboring forests before they are cleared. Post-harvest losses may be reduced by introducing women to more efficient technologies and means of storage as well as increasing their access to markets (FAO 2008). Empowerment through micro-loans has proven to be an effective means of demarginalizing women.

Cultural norms dictate how land rights are transferred and kept when a woman marries or is widowed; the risk that she will lose her formal property rights will likely affect her investment in long-term land management (FAO 2001). Norms may also close local politics to women despite inclusive processes—for example, if women themselves lack leadership ability due to inferior education (UNFPA 2008; The Bill and Melinda Gates Foundation 2008). New approaches are

supporting women's own knowledge networks and seeking to re-shape agricultural extension services to support them.

Can We Democratize Knowledge and Innovation Systems?

Given these challenges, it will be important for SOW11 authors to look not only at "agricultural innovations" that have promise, but also at "agricultural innovation systems." A variety of institutional models exist for locally adapting and scaling proven innovations, especially those that are more knowledge-intensive and require social learning support. Authors can also explore how national and international scientific and information establishments can be linked more systematically with empowered farmers and farmer networks.

7. Key Questions for *State of the World 2011*

Food-insecure regions of the developing world have experienced many "success" stories for agricultural innovation, but they are not scaling up (or out) sufficiently to eliminate hunger and food insecurity, even among producers or those served by rural markets.

Why? There is a notable fragmentation of effort, with poor coordination among farmer groups, NGOs, private businesses, and government agencies. Inputs and investment resources required for implementing innovations are simply unaffordable or inaccessible for the majority of farmers. There are no resources available in most farming communities for systematic location-specific research and testing of alternative approaches. "Scaling up" has too often been approached by increasing the number of people involved in a particular program, rather than mobilizing similar successful, smaller-scale initiatives more broadly.

It is also true that the enormous innovation occurring in many regions is invisible because the gains are overwhelmed by even faster rates of population growth and food demand, and by new challenges generated by climate and market changes and ecosystem degradation. In many places, even the definition of "success" is changing.

<u>Guidance for Authors</u>

To address these challenges, SOW authors might evaluate an agricultural innovation according to a variety of factors, including:

- How does it increase productivity, and under what conditions, and what are the impacts in the short, medium, and long-term?
- What do farmers like and not like about the innovation?
- Does it increase resilience of farming systems and farming households and communities to climate change and other environment and economic disturbances?
- Does it protect or restore ecosystem services and biodiversity (at the field, farm, landscape scales)?
- How dependent are the innovations on external inputs, knowledge, or services that may not be reliably accessible to low-income farmers and their organizations, or to women?

Other Recommendations

In addition, we hope authors will **explicitly consider the questions raised in sections 4, 5, and 6 above**: How do the agricultural innovations relate to the policy paradigms? Do these innovations contribute to integrated solutions for food security, climate change, livelihoods, and ecosystem restoration? What types of innovation systems and networks created and mobilized these innovations, and how accessible are they to food-insecure groups and individuals?

We can learn a lot from the variation in experience with innovations across different contexts. The SOW11 report might benefit from a **greater focus on "place": on considering the impact of a variety of innovations in places with particular ecological and socioeconomic conditions, rather than starting from the innovation and looking at its use**. The report could do more analytical mapping of the hunger diagnosis, at least in one country, to illustrate whether and how different strategies, and clusters of agricultural innovations, are needed to address different challenges.

The report can also **consider the diverse policy paradigms and evaluate and compare the approaches to find areas of broad consensus for action and research**, as well as to define contradictions that merit further examination. We expect that examples can be found from many of the "schools of thought" described earlier, and that these can be evaluated from an evidence base rather than from ideology. But this evaluation should also explicitly address factors that are important to groups with varying ideologies—for example, did the technology work only in places with secure tenure, or also places where it is not? What was the impact of high-tech market approaches on local food security? Who is actually eating the food produced by these systems (local food-insecure, local food-secure, other rural communities, urban communities, import buyers)? The report could potentially be framed to improve understanding and communication among the different communities of discourse.

References

25x'25. 2009. Agriculture and Forestry in a Reduced Carbon Economy: Solutions from the Land.

Altieri, Miguel A. and Clara I. Nicholls. 2008. Scaling Up Agroecological Approaches for Food Sovereignty in Latin America. Society for International Development 51(4): 472–80.

Battisti, David S. and Rosamond L. Naylor. Historical Warnings of Future Food Insecurity with Unprecedented Seasonal Heat. Science 323: 240.

Binswanger-Mkhize, Hans P. 2009. Challenges and Opportunities for African Agriculture and Food Security: High Food Prices, Climate Change, Population Growth, and HIV and AIDS. Expert Meeting on How to Feed the World in 2050. Food and Agriculture Organization of the United Nations (FAO).

Buck, L., E. Wollenberg, and D. Edmunds. 2001. Social learning in the collaborative management of community forests: lessons from the field. In E. Wollenberg, D. Edmunds, L. Buck, J. Fox, and S. Brodt, eds. *Social Learning in Community Forests.* CIFOR, Bogor, Indonesia. Pp. 1–20.

Buck, L.E. and S.J. Scherr, 2009. Building innovation systems for managing complex landscapes. In Moore, K.M., ed. The Sciences and Art of Adaptive Management: Innovating for Sustainable Agriculture and Natural Resources Management. Soil and Water Conservation Society, Ankeny, IA.

Collette, L. et al. 2008. Kenya International Center for Tropical Agriculture (CIAT) and Ecoagriculture Partners. Cali, Colombia.

Cook, Jonathon A. 2009. Smallholder Agriculture and the Environment in a Changing Global Context. WWF MPO. May.

D'Agnes, Leona, Judy Oglethorpe, Sabita Thapa, Dhan Ral, and Tara Prasad Gnyawali. 2009. Forest for the Future: Family Planning in Nepal's Terai Region. Focus on Population-Health-Environment #18. Woodrow Wilson International Center for Scholars and USAID.

FAO. 2001. Gender and Development Plan of Action. Rome.

FAO. 2008. Soaring food prices: Facts, perspectives, impacts and actions required. Paper prepared for the High-Level Conference on World Food Security: The challenges of climate change and bioenergy. Rome, Italy. June 3–5.

FAO. 2009a. The State of Food Insecurity in the World. Economic Crisis: impacts and lessons learned. Economic and Social Development Department. Rome.

FAO. 2009b. Crop Prospects and Food Situation. FAO Global Information and Early Warning System on Food and Agriculture. Rome. July.

The Bill and Melinda Gates Foundation. 2008. Gender Impact Strategy for Agricultural Development. www.gatesfoundation.org/learning/Documents/gender-impact-strategy.pdf.

Global Humanitarian Fund. The Anatomy of a Silent Crisis. Human Impact Report Climate Change. Geneva.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate change: Impacts, adaptation and vulnerability. Contribution of the Working Group II to the Fourth Assessment Report of the IPCC. Cambridge: Cambridge University Press.

McIntyre, Beverly D., Hans R. Herren, Judi Wakhungu, and Robert T. Watson, eds. 2009. International assessment of agricultural knowledge, science and technology for development (IAASTD): global report. Island Press, Washington, DC.

Milder, J., J.A. McNeely, S. Shames, and S. Scherr. 2008. Biofuels and ecoagriculture: can bioenergy production enhance landscapescale ecosystem conservation and rural livelihoods? International Journal of Agricultural Sustainability. Spring.

Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Organisation for Economic Co-operation and Development (OECD). 2008. Environmental Performance of Agriculture in OECD Countries since 1990. www.oecd.org/document/56/0,3343,en_2649_33793_40374392_1_1_1_37401,00.html#At_a_Glance.

Peters, Christian J., Nelson L. Bills, Jennifer L. Wilkins, and Gary W. Fick. Foodshed analysis and its relevance to sustainability. Renewable Agriculture and Food Systems, 24(I): 1–7.

Pretty, Jules. 2008. Agricultural sustainability: concepts, principles and evidence. Phil. Trans. R. Soc. B, 363: 447–65.

Roling, N.G. and M.A.E. Wagemaker, eds. 1998. Facilitating Sustainable Agriculture. Participatory Learning and Adaptive Management in Times of Environmental Uncertainty. Cambridge: Cambridge University Press.

Sanchez, P.A. and M.S. Swaminathan. 2005. Cutting World Hunger in Half. Science 307: 357–59.

Scherr, Sara J. and Jeffrey A. McNeely. 2008. Biodiversity conservation and agricultural sustainability: towards a new paradigm of ‘ecoagriculture’ landscapes. Phil. Trans. R. Soc. B, 363: 477–94.

Scherr, Sara J., Claire Rhodes, Louise Buck, Cosmas Ochieng, Robin Marsh, and Jenny Nelson. 2008. Farmer-Based Extension for SLM (Sustainable Land Management) in Africa. Ecoagriculture Partners, Washington, DC.

Scherr, S.J. and S. Sthapit. 2009. Mitigating Climate Change Through Food and Land Use. Worldwatch Report 179. Worldwatch Institute, Washington DC.

United Nations. 2009. The contribution of agriculture and land management to sustainable development. Sustainable Development Innovation Briefs, 7. May.

United Nations. 2006. World Population Prospects. The 2006 revision population database. http://esa.un.org/unpp/.

United Nations Environment Programme (UNEP). 2009. The environmental food crisis—The environment's role in averting future food crises. A UNEP rapid response assessment. GRID-Arendal, www.grida.no.

United Nations Millenium Project. 2005. Halving Hunger: It Can Be Done. Task Force on Hunger.

United Nations Population Fund (UNFPA). 2008. State of World Population. http://europe.unfpa.org/webdav/site/europe/shared/Publications/PDF%20files/swp08_eng.pdf.

Wood, Stanley and Simeon Ehui. 2005. Chapter 8: Food. In Ecosystems and Human Well-being: Current State and Trends.

Wood, Stanley, Kate Sebastian, and Sara J. Scherr. 2000. Pilot Analysis of Global Ecosystems: Agroecosystems, A joint study by International Food Policy Research Institute and World Resources Institute, International Food Policy Research Institute, and World Resources Institute, Washington, DC.

Annex I. Overview of Hunger and Food Security [see separate document]