

Sharpening the Focus on Poverty in Public International Agricultural Research for Development

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Abstract

The priority goal of international public agricultural research is to reduce poverty and food insecurity, through research supporting smallholder-based sustainable agricultural development. However, this mandate has expanded too widely for available resources. An appropriate niche for international public sector research institutions would be to emphasize research needs of persistently poor rural populations, that require new research approaches and are most poorly served by other actors in the evolving global agricultural research system. Such research would prioritize:

- 1) Strategic research to understand the causes and patterns of rural poverty-agriculture-environment interactions, and implications for technology and policy design;
- 2) Sustainable technology development for highly-populated marginal lands, particularly in the warm tropics where the largest number of rural poor people live;
- 3) Resource management strategies and institutional arrangements to ensure access by the poor to environmental resources critical for livelihood security; and
- 4) Explicit analysis of policy impacts on the food-insecure, and advocacy for policy action favoring the poor.

To implement these objectives, a decentralized and participatory research strategy is needed, based on long-term partnering with development organizations and poor people.

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Introduction

The emerging paradigm of the “Doubly Green Revolution” in international public agricultural research, as expressed in the Lucerne Declaration of 1995, integrates environmental concerns and constraints into the research agenda, establishes poverty reduction as the principal mandate, and seeks to reach the poor by focusing research on resource-poor groups. However, the scope of this research challenge, given current financial constraints, is unwieldy to manage and precludes concentration of effort. In this paper we argue that the poverty focus could be more sharply defined by emphasizing research challenges for the most persistent aspects of poverty that require new research approaches and are under-studied by other actors in the global research system.

The following section describes the myriad research demands of the development paradigm of broad-based smallholder-led growth, and the changing landscape of research supply. The third section describes four “big gaps” in poverty-related agricultural research, and how a research agenda could be devised to address them. The fourth suggests organizational changes that would have to accompany such revised priorities, with conclusions and remaining questions in the final section.

Evolving consensus around smallholder-based sustainable agricultural development

The original “Green Revolution” of the 1960’s and 1970’s was predicated on the assumption that food supply constraints were an over-riding cause of food insecurity in developing countries. The application of scientific plant breeding to dominant staple food crop production on irrigated and high quality farmland, together with chemical inputs and market development, did indeed lead to large supply increases. Food availability per capita is 15 percent higher now than 20 years ago. However, in the subsequent two

decades, it became clear that the Green Revolution strategy was not enough to address persistent rural poverty and food insecurity. Many farmers were “left out” of, or negatively affected by, the Green Revolution (Ravnborg 1992). In the 1990’s, about 40,000 people died every day in hunger-related causes; 840 million people were chronically malnourished (compared to 900 mln 25 years ago).

Approximately 20% of the world’s population—1.3 billion people—live in poverty; over 70% are women. In Sub-Saharan Africa, close to half of the population falls below the poverty line (FAO 1996; World Bank 1997; UNDP 1998; FAO 1996). Poverty is currently, and is projected to remain, predominantly a rural problem. Of nearly one billion poor identified in 58 poverty profiles completed by the World Bank, 72% live in rural areas. Although by 2020, the urban population of developing countries is expected to reach 3.6 billion people, nearly three quarters of the poor will continue to live in rural areas, and a significant majority will depend upon agriculture for their livelihoods (World Bank 1997; Scherr 1999).

The international agricultural research community has largely come to agree with the position of the World Food Summit of 1996, that poverty itself--not aggregate food supply--is the greatest cause of food insecurity. Smallholder-based agricultural development is considered the most effective strategy to achieving both food security and economic development in poor countries. Research shows that the rural poor depend more on agriculture and on common property resources than the rural non-poor. To achieve food security, it matters where agricultural production takes place and who receives the associated income. Only if more rapid agricultural growth occurs in regions with impoverished rural population can rural farm and non-farm income rise sufficiently

to enable the rural poor to afford more and better food. Their prosperity depends substantially on forward and backward farm production and consumption linkages (Delgado et al. 1998; IFPRI 1997; Malik 1998; Scherr, in press; World Bank 1997).

Agricultural research is considered, in various paradigms, as a key element in the strategy to achieve successful and sustainable smallholder development. The *new modernist* school emphasizes the potential for increasing productivity and incomes through increased and more environmentally sensitive use of modern inputs (fertilizer, pesticides and biotechnology) (IFPRI 1995; McCalla 1994; Vosti and Reardon 1997), while the *low external input* school emphasizes use of fewer external input and regenerative technologies, adaptation of indigenous technologies; and greater concern for local and national self-sufficiency, particularly in currently unimproved or degraded land bypassed by the original Green Revolution (Altieri, Rosset and Thrupp 1998; Pretty 1997, Reijntjes, Minderhoud-Jones and Laban 1998). These schools are finding common ground around the concept of *sustainable intensification* or “*sustainable agricultural development*”—a “doubly green revolution” with a particular focus on the poor (Conway 1997; Bie 1997; Scherr 1997). Meanwhile, mechanisms to better address the needs of poor farmers have developed, such as farming systems and participatory research methods (Selener 1997; Chambers and Conway 1992; Ravnborg 1992).

Time to Consider New Priorities in Public International Agricultural Research?

But within this revised paradigm it is difficult to set priorities for public international agricultural research, in relation to the over-riding poverty objective.

Development-Environment-Poverty: Institutional Over-Commitment

As a guide for agricultural research in developing countries, the “smallholder-based sustainable development” model is highly robust. However, the research agenda implied by this model is broad indeed, covering everything from reducing environmental externalities in irrigated agriculture, to protecting rainforests from agricultural migrants, to identifying technical constraints to soil management in highly diverse marginal lands. The difficulties in selecting international priorities from among so many worthy topics and groups of people has led to a proliferation of research programs, most of which are greatly under-funded relative to demand or expectations of global impact. The system cannot, within existing resource constraints, respond energetically to the challenges of persistent food insecurity of marginalized farmers, while still supporting the myriad research demands to maintain smallholder-led sustainable development and environmental protection in high-quality lands.

Changing Institutional Landscape in Global Agricultural Research

Perhaps it need not. The institutional landscape for agricultural research has changed since the 1960's, when international public sector research played a dominant role in tropical smallholder agriculture. Research by other sectors has expanded greatly, in particular that focused on productivity and sustainability, and to a lesser extent poverty, in ecologically favored lands (defined as fertile, well-drained, even topography, adequate rainfall, and under comparatively intensive use with low risk of degradation), in economically favored regions.

Private sector research has expanded notably, mostly geared to large-scale commercial agricultural production, out-grower schemes, and seed and agricultural inputs

for smallholder commercial production. In the use and development of biotechnology, the private sector dominates, so that the applications and benefits of biotechnology are currently skewed to the markets of the rich and largely exclude the concerns of the poor (Tripp 1999; Serageldin 1999). Many commodity-based producer organizations now carry out sophisticated research on commercial and export crops. Advanced research institutes (ARI's) in developed countries play a growing role in basic and strategic research but are not usually targeted to concerns of the poorest.

Many public national agricultural research institutions, especially in larger countries, are well-established with well-trained personnel. They typically emphasize a limited number of commodities, primarily important export and urban food crops, and either larger-scale commercial producers or smallholders in economically and ecologically favored environments. They prioritize research with high pay-offs in the short term, particularly since budgets have been cut as a result of structural adjustment. The quality and efficacy of research for poor farmers in favored areas is often constrained more by policy and financing than by the stubbornness of scientific challenges.

Non-governmental organizations (NGOs) and some development agencies have become important players in adaptive agricultural research and extension for the poor, and have played a leadership role in developing research approaches and technological innovations suitable to economically and ecologically marginal conditions. Yet, such efforts still receive minimal support from national and international research systems, and by mandate, their research does not address many strategic research questions.

The CGIAR institutions have expanded their activities in direct support of poor people, modifying germplasm selection criteria, increasing participatory technology

development, and devising management systems for resource-poor farmers. They have also expanded research in marginal lands, incorporating natural resource management-oriented centers (ICRAF, CIFOR, ICLARM) and through eco-regional programs in tropical hillsides, mountains, etc. However, the CGIAR accounts for only about 3-5% of the global agricultural research budget (though up to 14% in parts of Africa). And of this, a large proportion of the budget supports research for smallholder-based sustainable development in favored areas. Of 374 projects in 1997, only 25% were fully targeted on poverty in marginal lands, and 7% on poverty in more favored lands. Although two thirds of resources were allocated to marginal lands, three quarters of that was to increase the sustainable productivity of lands of high agro-ecological potential (e.g., cracking black cotton clays of India and inland valleys of West Africa) (Nelson, et al. 1997).

The Big Research Gaps in Relation to Poverty

Public international agricultural research would seem to have a comparative advantage in addressing those aspects of the smallholder sustainable agriculture research agenda that specifically target persistent poverty, and which other actors are unlikely to address in the scope and depth required. Four big research gaps are especially evident. By concentrating efforts, real breakthroughs may be possible.

1) Understanding Causes and Patterns of Poverty-Agriculture-Environment

If poverty is the main cause of food insecurity, we need to start by examining where the poor are, who they are, and why they are poor (Haug 1998; Maxwell 1999). We have a rich body of information today on poverty, as defined by income and food consumption. We have identified many factors at global, regional, local, household, and individual levels that affect patterns of poverty and food insecurity (Table 1).

But because of the lack of inter-temporal and spatially explicit studies on agriculture, poverty and environment, we have a poor empirical understanding of the processes that create and perpetuate poverty, particularly the environmental determinants of poverty, and the effects of poverty on the environment. There are encouraging findings from empirical studies that population increases in ‘marginal lands’ can be associated with improved natural resource conditions, as well as higher productivity (Forsyth and Leach 1998; Templeton and Scherr 1999; Tiffen and Mortimore 1994, Turner, Hyden and Kates 1993). However we do not fully understand the micro and macro factors behind such results. In a poverty-focused agenda, such poverty-agriculture-environment interactions would be a core focus of scientific research.

Such research must move beyond narrow formulations of food security, to assess “livelihood security”, i.e., the extent to which people’s capabilities, assets (including physical, social, financial, human and natural capital) and activities provide secure means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the resource base (Chambers and Conway 1992; Farrington, et al. 1999).

Rigorous studies are needed that track changes over time in poverty, agricultural productivity and environmental conditions in different types of landscape, ecozones and demographic conditions, so that we can understand what types of development pathways encourage poverty reduction with sustainable intensification (Scherr, et al. 1996; Pender, Scherr and Duron 1999). We must understand the *processes* of impoverishment (Dreze and Sen 1989), including how people gain control over environmental resources and

services. Through micro-understanding of differentiation among poor groups, it should be possible to distinguish technology and policy priorities and impacts.

While farm and plot-level studies remain important, studies of poverty and production in marginal, usually heterogeneous, environments need to be grounded in a higher-scale landscape/lifescape perspective (Neely, Buenavista, Earl 1999). Patterns of interaction between land use and management in different parts of the landscape, by different groups of people, need to be identified in diagnosis and considered explicitly in designing technical or institutional innovations. It is important to understand which landscapes are populated predominantly by the poor and where the poor are situated in otherwise non-poor landscapes, and use this knowledge of spatial dynamics to design studies and select experimental sites. On-farm (-forest) research would be prominently used to handle spatial heterogeneity, provide ecological monitoring, and observe farmer management (Scherr 1991; Franzel and Scherr forthcoming). As with other research on system sustainability, inter-temporal dynamics is an essential concern of research. Researchers would be concerned with reconstructing past patterns and trends of resource management (through informant recall, archival records etc.); integrated poverty-agriculture-environment data in recurrent public surveys; and monitoring innovations over more extended time periods (Scherr, Pender and Bergeron 1997).

Strategic and applied research would seek a fundamental understanding of the ecological function and impacts of agricultural land and resource uses by the poor, as well as the potential of human-modified habitats to generate products and services that increase food security and environmental health. Socioeconomic and human ecology research could explore more effectively poor people's own strategies to improve food

security in difficult environments and draw lessons for designing technologies, institutional interventions, and policies.

Studies of poverty-agriculture-environment interactions should evaluate how agricultural research could improve situations for the poor, and produce guidelines for agricultural, livestock, forestry and fisheries technology design. These would relate to farmers' resource endowments, scale of production and exposure to high livelihood risks, as well as regional economic and environmental conditions (Scherr in press, b). Priority traits for germplasm selection and improvement could be thus defined, as well as opportunities to achieve significant yield increases in indigenous and secondary crops, animals and trees that have not yet been well-studied. Information on yields of different groups of farmers on different land types, can identify group- and land quality-specific opportunities for significantly increasing yields (Ravnborg 1993).

Much of this kind of research will necessarily entail intensive primary data collection, with formal surveys complementing participatory research used to elicit poor people's own perceptions, strategies and innovations. While the development of low-cost research methods should be a long-term objective, strategic research studies in core research sites may be fairly expensive. To ensure that results are more widely extrapolable, the representativeness of study sites should be formally evaluated through low-cost survey or GIS methods. To ensure their practical contribution to development, such studies would preferably be linked to on-going development efforts in the study regions.

Past research planning based on commodity and agro-climatic information alone has been justifiably critiqued as leaving out the "people factor". Studies described above can make possible the development of geo-referenced databases that link poverty, key causal

factors of poverty, agro-climatic and socio-economic information, at sufficiently small scale to distinguish land quality types, as recommended by Nelson, et al. (1997:19).

2) *Technology for Highly-Populated Marginal Lands, Especially the Warm Tropics*

We join UNDP (1998) in arguing for a “Second Green Revolution” aimed at poor people in fragile ecological zones. Within this broad category, however, the international public research agenda would be sharply focused on farming systems in ecological conditions where the food-insecure are concentrated and that have least benefited from previous research. Other research actors would be responsible for research to support poor farmers in other geographic zones, sustainability in the principal commercial producing areas, and other topics.

Spatial patterns of poverty have evolved differently since the 1960’s in pathways with different land resource endowments, settlement patterns, and climates. Expansion and intensification of irrigated agriculture and intensification of high-quality rainfed lands have benefited greatly from strategic investments in international agricultural research. However, by the early 1990’s, only an estimated third of all rural poor in developing countries resided in ecologically favored lands, even though there is no evidence that the *incidence* of poverty is lower there (Table 2).

Rather, the past 40 years have seen significant intensification of densely populated marginal land, and expansion of farming into sparsely-populated marginal lands. Two thirds of the rural poor now reside in marginal agricultural, forested and arid lands. Perhaps a third of the rural poor in ecologically marginal areas are in low population density areas where shifting cultivation and herding systems are practiced. But most now live in densely populated marginal lands that must be managed intensively to

meet food needs, at risk of degradation. Even with high rates of out-migration, it is unlikely that total population in these regions will decline any time soon (Scherr 1999).

Accelerated urbanization has been accompanied by the growth of urban and peri-urban farming, and globally these little-researched systems may be of high priority for addressing urban poverty. But there would seem to be considerable opportunity to mobilize other research actors to address these issues.

The geographic focus of research could be further narrowed to highly-populated marginal lands where climatic conditions significantly constrain the application of existing agricultural technology. These criteria would argue for an emphasis on the warm tropics. Globally, three fifths of all malnourished children (an excellent indicator of poverty) in the developing world reside in the warm tropics (Table 3; Sharma et al, 1996). Furthermore, the warm tropics pose especially daunting ecological challenges to the management of soil fertility, water, pests and diseases, and plant communities, with more limited scope for drawing insights from the abundant agricultural research output of the developed temperate countries (Sachs 1997). Basic information is lacking on characteristics and management of major soil types now important for intensification (Tengberg and Stocking 1998).

Grain-dominant farming systems appear to be ecologically unsuitable in much of the warm tropics. But there are exciting long-term opportunities to develop and promote more ecologically suitable crops, trees and animals--for consumption, national markets and exports. This would not be a process of adapting technologies already developed for the favored areas, but rather devising new productive strategies for which these lands have a comparative advantage.

A secondary priority for international public research could be poor people in less densely-populated areas in both the tropics and sub-tropics whose farming systems threaten ecologically important natural resources, for example, rare wildlife habitats, coral reefs, or critical watersheds. The enhanced expertise in poverty-agriculture-environment interactions would be relevant to such work, and there is likely to be a gap in work by other international and national actors, particularly in support of the poor.

In these, as in other marginal lands, affordable methods must be found to build up or stabilize the resource base (the “natural capital”), before sustainable intensification will be either possible or economic (Scherr 1999). Community- and watershed-scale planning, with associated regulatory, pricing and organizational changes, will often be needed to enable transformation to more sustainable, higher-productivity landscapes. New institutional mechanisms to mobilize labor and capital for resource-improving investment may need to be devised (Scherr, in press).

Farmers are clearly already adapting and innovating to meet the challenges of intensification on marginal lands of the tropics. Indeed their innovations can fruitfully be documented and disseminated to farmers in less intensively managed lands. However, science-based research can provide strategically important input, in particular for agroecological conditions that have not historically been managed intensively.

Distinct avenues of research may need to be pursued in areas with good market access and with poor market access. It is highly feasible for some ecologically marginal lands with good market infrastructure to be transformed into major contributors to broad-based sustainable development. But areas with poorly functioning product and factor markets offer quite different opportunities as regards product mix, use of external inputs,

and food security strategies. Even with optimistic projections of infrastructure development, there will be little likelihood, over very large areas of humid and sub-humid Africa with high and growing populations, of providing sufficient rural road investment by 2020 to achieve even the infrastructure levels existing in India in 1950, before the Green Revolution had begun (Spencer 1994). Similar conditions constrain other remote areas, like some mountain ranges in Asia. Yet there has been relatively little research to design sustainable agricultural systems suitable for such conditions.

One strategy for international public research, then, is to emphasize smallholder crop, livestock, forestry and fishing systems in the densely-populated marginal lands of the warm tropics, where at least half of the rural food-insecure in developing countries are living. Particular attention would be paid to economically- marginalized and food-insecure people, such as poor women farmers, the large tribal groups in montane southeast Asia and the Himalayan foothills, and dryland farmers in sub-Saharan Africa.

3) Ensuring Access by the Poor to Environmental Resources for Livelihood Security

A third element of a poverty-focused research agenda, that has been little addressed to date by public international agricultural research, is securing access by the poor to natural resources critical for livelihood security. This concern has been marginalized in the dominant global agenda of “sustainability” and “environmental protection”. One aspect of that agenda has been environmental constraints to agricultural growth, such as long-term sustainability of production on high-quality lands and fisheries, and management of water scarcity or salinization in irrigated lands. A second aspect has been protection of environmental qualities of interest to urban people and the international conservation community, such as control of agricultural externalities like

pollution from agro-chemicals and animal waste, or sedimentation from eroded cropland, and protection of biodiversity and natural habitats, such as forests (see Table 2).

Priority environmental issues for the rural poor are typically different. One key aspect was discussed above--preserving or improving their natural capital to support higher and more stable production of food, fodder and fibre. In addition, the poor are concerned to protect local water quality and supply; maintain forest, woodland, grassland, river and coastal resources that contribute to food security; reduce environmental risks to their livelihoods; enhance the quality and healthiness of human habitat; and protect their access and control over natural resources (including land) against encroachment by more economically powerful groups. Yet their voices and perspectives are rarely heard when legislation on rights of access to natural resources is drafted, or land and resource use plans are devised at local, national or international levels. Such concerns are targeted in recent research on “environmental entitlements” (Forsyth and Leach 1998), “ecological security” (Agarwal 1998), and livelihood security (Chambers and Conway 1992).

Anticipated changes over the next few decades make it likely that environmental issues will become increasingly important for the poor. Water scarcity, deforestation, and population pressure on cropland are predicted to increase significantly by 2020 (IFPRI 1995), hence conflicts over resources are expected to become an even more important source of livelihood insecurity in the future. Marginal lands will necessarily experience further agricultural intensification. To maintain and intensify farm, forest and fisheries production will require substantial investments in land and natural resource-improvements, and development of new management systems. Institutional innovations will be needed to ensure regular access of *all* people to natural resources critical for

livelihood security. With population growth and urbanization, large areas in many developing countries will become multi-functional landscapes serving jointly for human settlements, agricultural production and environmental services. Conventional planning and research paradigms, that assume spatially segregated land uses, will become irrelevant in these areas. Scientists, land managers, and policymakers will need to find strategies for agricultural production that not only ensure poor people's food security, but also produce *positive* environmental externalities, to protect livelihoods of the poor as well as other values (Scherr 1999).

Exciting and innovative development initiatives are being undertaken around the world to address these environmental problems of the poor. But research support for those initiatives has been minimal. Resource access and quality concerns have not even been incorporated much into agricultural technology and natural resource management design, although there are relevant initiatives in international public research. For example, some studies in the CGIAR System-Wide Program on Property Rights and Collective Action address property rights issues around water and forest resources, and both ICRAF and the SANREM program and their partners have undertaken initiatives to evaluate multi-functional agricultural landscapes. But they do not specifically focus on meeting the needs of the poor.

Policy Impacts on the Poor and Policy Advocacy

A fourth key theme in a poverty-focused international research agenda would be policy research from the perspective of the poor and food-insecure. Policies would be evaluated to determine their impacts on specific food-insecure groups (for example, by ecozone, wealth class, gender, farming system), not only their aggregate or "average"

impact on incomes or environment. Such assessment is needed on existing and proposed international and national policies on trade, macroeconomic management, agricultural prices, environmental protection, foreign agricultural investment, foreign aid, property rights, local governance of natural resources, and public investment. Studies would measure trade-offs between achieving aggregate economic growth or environmental quality and providing additional food security for the most vulnerable groups, and suggest policy alternatives that minimize food insecurity. Where existing statistics do not permit the necessary disaggregation, researchers would undertake primary data collection and analysis in representative sites to understand the macro-micro linkages and impacts, as has conventionally been done to assess food policy impacts.

Policy research would be pro-active, seeking out and evaluating innovative policies and institutional arrangements to integrate poverty, productivity and environmental objectives. Examples include: mechanisms for co-investment in the on-farm natural resource assets of the poor; employment of the poor in projects to improve the agricultural resource base; extension strategies for promoting environmentally friendly technologies in poor and marginal farming areas; and mechanisms to compensate the poor for conserving or managing natural resources valued by others; mechanisms to facilitate access of the poor to natural resources essential for their livelihoods, as well as access to appropriate institutions (Scherr, in press,a). Policies could be compared over time and space, and in different agro-environments, to determine their actual impacts on food security, agricultural productivity and environmental quality. International researchers would generally work closely with line ministries to encourage ownership of policy findings, and with universities to enhance capacity to undertake policy research

with a poverty focus. Participatory policy research needs to be greatly strengthened, to ensure that different actors, in particular representatives of poor client groups, are involved in setting research objectives and evaluation criteria (Oshaug and Haddad 1998; Scherr, Pender and Bergeron 1997).

Food security is a question of equity, distribution, power and politics as well as food production (Haug 1998). Political economy and political ecology would be key tools of policy research, to understand processes of policy formulation and implementation. Studies would seek to identify strategic options to address broad constraints to poverty reduction such as agrarian structure (Ravnborg 1993), human rights and the political voice of the poor (Oshaug and Haddad 1998), and access and control by the poor to productive resource control (Stonich 199?). The broader political context for agricultural change and poverty impact might be considered as a factor in setting research priorities. Cleaver (1997) concluded several years ago that only five African countries had a policy that could be defined as “poverty-oriented” while a few others were “neutral”; the majority had policies which exacerbated poverty problems. International researchers may wish to concentrate their work, particularly longer-term studies, in countries or sub-regions with demonstrated commitment to anti-poverty measures.

Poverty-focused international agricultural research institutions could play a more active role in promoting effective policies for poverty reduction and food security in national and international policy forums. IFPRI’s (1995) initiative for “A 2020 Vision for Food, Agriculture, and the Environment” has been a notable move in that direction by promoting information and dialogue. ICRAF’s policy program in Southeast Asia has

helped to promote national land use policy changes in study countries. Such initiatives could be strengthened to serve an advocacy role for the most food-insecure groups.

Public international researchers could be less hesitant than in the past about building institutional bridges directly with local and national advocacy groups for the poor. Some caution is needed to maintain the appearance and reality of objectivity in the eyes of more powerful political actors, but this should not require distancing from the institutions representing our principal clients. In many cases, international agricultural research institutions provide the “convening power” that can make possible policy dialogue between national groups that would otherwise have little opportunity or incentive to meet. CIMMYT, for example, has played such a role in Mexico and Central America, bringing together local policymakers, farmers groups and scientists to catalyze policy changes needed to support new technology adoption (ref).

Implications for Research Implementation

The research institute-centered technology development model needs to be revised if the goal is to have direct impact on the poor. The paradigm of sequential technology development (diagnosis, followed by researcher design and testing, then on-farm research testing and farmer testing, and finally extension) is time-consuming and poses significant risk of producing results with limited impact. Further, a centralized scientific research program—whether international or national--cannot handle more than a fraction of the commodity, ecosystem, and farming system problems that pose important research challenges. Most technology development (apart from high-tech breeding work) and adaptive research will necessarily be done by development institutions, such as extension agencies, NGO’s, projects, and farmers’ organizations, and adapted by farmers.

A more decentralized research strategy needs to be considered. For example, formal or informal networks could link international research partners with adaptive research and farmer monitoring programs working on sustainable, poverty-oriented landscape development in similar agroecosystems. The international partners could provide methodological back-stopping for adaptive studies, undertake strategic and applied research to answer key questions arising from development efforts and adaptive research, and facilitate information exchange among network partners and the broader international community. By using the adaptive research sites and farmer monitoring systems to collect inter-temporal data integrating poverty, environment and agriculture factors, researchers could also test and quantify fundamental questions about agroecosystem functioning and relationships with poverty at community and landscape scales. Proposed policy innovations could be designed as pilots and tested through the network.

This decentralized process could strengthen the role of poor people in research planning and implementation. More participatory research approaches present various advantages. Farmers and researchers can work as partners in the technology development process, providing early farmer assessment and innovation. Biophysical performance can be evaluated under a range of conditions, and realistic input and output data collected for economic analysis. Important diagnostic information can be obtained about farmers' practices and preferences (Scherr and Franzel, forthcoming; Neely, Buenavista and Earl 1999). This would be particularly effective in longer-term research sites where trust relationships can be built, perceptual differences between farmers and researchers clarified, and researchers can directly observe landscape and lifescape changes over time.

Many cases illustrate the potential to improve research effectiveness and efficiency through extended farmer partnerships. Agroforestry technologies developed by ICRAF and its collaborators in Kenya and Zambia were improved through farmer planning input, on-farm testing, and farmer evaluation (Franzel and Scherr, forthcoming). Community groups working with the Chivi Food Security Project in Zimbabwe efficiently evaluated and selected water-harvesting practices for research testing (Murwira, et al. 1996). The CGIAR Program on Participatory Research and Gender Analysis is experimenting with a variety of approaches and research tools to assess when, how and why participatory approaches are more effective than conventional research (Fernandez, et al. 1998). Methods for research priority-setting with the poor are being developed (Bebbington, Merrill-Sands, and Farrington 1993; Franzel, et al. 1999).

Moving to a Poverty-Focused International Public Research Agenda

Our thesis is that a highly suitable and promising niche for public international agricultural research is to support the needs of persistently poor populations whose technology and policy research needs are most poorly served by other actors in the evolving global agricultural research system. The implication of this would be a significant narrowing of the spatial focus of research, a sharpening of research topics around a few main themes (four are suggested above), and organizational change to link research more directly with on-the-ground development action.

Many questions arise from such a re-thinking of priorities. First, how can other international and national research actors effectively provide leadership in pursuing the still-important smallholder sustainable development research agenda for irrigated and high-quality rainfed lands? New institutional and financing arrangements may be needed, with particular emphasis on South-South collaboration and involvement of ARI's, the private sector, and bilateral and multilateral development agencies. How can the many lessons that have already been learned about integrating concerns of the poor into sustainable agricultural research and policy in more favored lands be more widely disseminated and utilized, and supported by policy reform? How could a new poverty-focused research strategy be effectively communicated to staff and stakeholders of the public international agricultural research community? How would organizational incentives have to change in order to ensure high quality, impact-oriented research? How should criteria and methods for research impact assessment be changed to reflect a sharper focus on poverty reduction?

Finally, will it be possible to generate the passion and imagination needed to successfully overcome food insecurity in these more challenging environments (Lang 1996)? Researchers in the international system must analyze with their heads, but be motivated by their hearts. They will not otherwise sustain the difficult task of orienting their work to the practical needs of the poorest and ensuring the results have real impact.

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Table 1. Global, Regional, National, Household and Individual Factors Affecting Food Security*

Global:

- Political structures, power relations, market mechanisms
- Macro politics/political economy and policies
- International trade; i.e., raw material prices, GATT/WTO, commodity market structures
- International debt
- Food aid and agricultural assistance
- War and conflict situations

Regional/National:

- Political structures and power relations
- Agricultural policies
- Terms of trade for national export products relative to imports
- Environmental policies
- Inequities regarding property rights
- Population growth and population pressure
- Degradation of natural resources, droughts, floods and other natural calamities
- Water, political, religious and/or ethnic conflicts
- Local participation, status of women in society

Local/Household/Individual:

- Purchasing power, access to income-generating activities or employment opportunities
- Access to productive resources such as land, water, pasture, forest, biodiversity
- Labor availability to perform agricultural activities
- Availability of inputs, capital and credit;
- Access to markets, institutions for marketing and input distribution;
- Quality and quality change of natural resources, natural disasters
- Status of women and minority groups (religious, ethnic) in society
- Inter-household relations
- Opportunities for human resources development
- Health limitations (e.g. AIDS).

* Haug 1997, p.6.

Table 2. Pathways of Agricultural Change and Environmental Impacts*

Land type	% arable land	% population	Changes in recent decades	Common problems of land degradation
Irrigated lands	7.5	35 of rural pop'n	60% increase in irrigated area, 1961-90; increased multi-cropping; HYVs, high agro-chemical use	• Salinization and waterlogging • Nutrients imbalance • Biological degradation (chemical) • Nutrient pollution in groundwater • Water-borne diseases • Water conflicts
High quality rainfed lands	23		Transition from short fallow to continuous cropping, HYVs mechanization, high agro-chemical use	• Nutrient depletion • <i>Physical degradation</i> • Acidification • De-vegetation, loss of perennials • Biological degrad. (chemicals) • Pesticide pollution • Deforestation of commons
Dense-populated marginal lands	69	65 of rural population	Transition from long to short fallows/continuous cropping; use new landscape niches, low input use	• Soil erosion • Soil fertility depletion • De-vegetation, biodiversity loss • Soil compaction • Acidification • Watershed degradation
Extensively managed marginal lands			Immigration and land-clearing for low input agriculture	• Soil erosion from land-clearing • Soil erosion from cropping • Soil nutrient depletion • Weed infestation • Biological degrad. (topsoil loss) • Deforestation, loss of biodiversity • Watershed degradation
Urban and peri-urban land	No data	33-80 of urban households	Rapid urbanization; expansion and diversification of urban food markets; urban poverty, unemployment	• Soil erosion from poor practices • Soil contamination • Over-grazing and compaction • Air and water pollution • Human disease vectors

* Scherr 1999

Table 3. Geographic distribution of Malnourished Children, by Ecozone*

	TROPICS	SUB-TROPICS	TROPICS AND SUB-TROPICS
WARM			
# malnourished children, millions (% all malnourished children in developing countries)	106.5 (58.2)	39.1 (21.3)	145.6 (79.5)
# hectares of arable land, millions (% of all arable land in developing countries)	353.7 (40.7)	153.7 (17.7)	507.4 (58.4)
WARM/COOL			
# malnourished children (% of all arable land)	----	10.4 (5.7)	10.4 (5.7)
# hectares of arable land, millions (% of all arable land)	----	112.1 (12.9)	112.1 (12.9)
COOL			
# malnourished children, millions (% of all malnourished children)	8.1 (4.4)	18.8 (10.3)	26.9 (14.7)
# hectares of arable land, millions (% of all arable land)	32.1 (3.7)	193.9 (22.3)	226.0 (26.0)
ALL			
# of malnourished children, millions (% of all malnourished children)	114.6 (62.6)	68.3 (37.3)	183.4 (99.9)
# hectares of arable land, millions (% of all arable land)	385.8 (44.4)	459.7 (52.9)	845.5 (97.3)

*Based on Sharma, et al. 1996.