INDEPENDENT IMPACT ASSESSMENT REPORT No. 43

# Balancing International Public Goods and Accountability: Exploring the Impact of IFPRI's Policy Research on Science, Technology, and Innovation

John K. Lynam

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
IFPRI

CGIAR
RESEARCH PROGRAM ON Policies, Institutions, and Markets
Led by IFPRI

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The International Food Policy Research Institute (IFPRI), established in 1975, provides research-based policy solutions to sustainably reduce poverty and end hunger and malnutrition. The Institute conducts research, communicates results, optimizes partnerships, and builds capacity to ensure sustainable food production, promote healthy food systems, improve markets and trade, transform agriculture, build resilience, and strengthen institutions and governance. Gender is considered in all of the Institute's work. IFPRI collaborates with partners around the world, including development implementers, public institutions, the private sector, and farmers' organizations. IFPRI is a member of the CGIAR Consortium.

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The CGIAR Research Program on Policies, Institutions, and Markets (PIM) leads action-oriented research to equip decisionmakers with the evidence required to develop food and agricultural policies that better serve the interests of poor producers and consumers, both men and women. PIM combines the resources of CGIAR centers and numerous international, regional, and national partners. The program is led by the International Food Policy Research Institute (IFPRI). www.pim.cgiar.org

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**Series Name Change Announcement**

The Impact Assessment Discussion Paper (IADP) series has been renamed "Independent Impact Assessment Report" beginning with report #36, and the numbering for this series will continue from the IADP series.

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# LIST OF ACRONYMS

| | |
|---|---|
| AIS | Agricultural innovation systems |
| ASARECA | Association for Strengthening Agricultural Research in Eastern and Central Africa |
| ASTI | Agricultural Science and Technology Indicators |
| CCF | Consolidated conceptual framework |
| CGE | Computable general equilibrium |
| CGIAR | Consultative Group on International Agricultural Research |
| CGS | Competitive grants system |
| CIFOR | Center for International Forestry Research |
| CRPs | CGIAR research programs |
| CSSPs | Country strategy support programs |
| DFID | Department for International Development |
| DREAM | Dynamic Research EvaluAtion for Management |
| EAAPP | East Africa Agricultural Productivity Program |
| ECA | Eastern and Central Africa |
| EPMR | External Program and Management Review |
| EPTD | Environment and Production Technology Division |
| EU | European Union |
| FAO | Food and Agriculture Organization of the United Nations |
| GCDT | Global Crop Diversity Trust |
| GIS | Geographical information system |
| GM | Genetically modified |
| GPA | Global Plan of Action |
| GPG | Grant proposal guide |
| GRP1 | Global Research Program 1. Timeline or evolution of GRP1: Global Research Program on "Agricultural Research, Extension, and Education Policy" (in 1996); "Agricultural Science and Technology Policy" (in 1999); "Policies for Biotechnology and Genetic Resources Management" (in 2002); "Genetic Resources Policies: Biodiversity and Biotechnology" (in 2003); "Genetic Resource Policies" (in 2007); "Genetic Resource Policies for the Poor" (in 2011) |
| GRP29 | Global Research Program on Institutional Change and Agricultural Innovation Systems |
| GRP30 | Global Research Program on Organization and Management for Strengthening Agricultural Research |
| GRP31 | Global Research Program on Agricultural Science and Technology Policy |
| GRP35 | Global Research Program on Learning and Capacity Strengthening |

| | |
|---|---|
| GRPSP2 | Spatial Analysis Group |
| IFPRI | International Food Policy Research Institute |
| ILRI | International Livestock Research Institute |
| IPGs | International public goods |
| IPGRI | International Plant Genetic Resources Institute |
| IPR | Intellectual property right |
| ISI | Information Science Institute |
| ISAAA | International Service for the Acquisition of Agri-biotech Applications |
| ISNAR | International Service for National Agricultural Research |
| ITPGR | International Treaty on Plant Genetic Resources |
| KARI | Kenya Agricultural Research Institute |
| KCID | Knowledge, Capacity, and Innovation Division |
| MDGs | Millennium Development Goals |
| MP4 | Multicountry Research Program on Agricultural Research, Extension, and Education Policy |
| NARIs | National agricultural research institutes |
| NPPs | Networks, programs, and projects |
| NRM | Natural resource management |
| ODA | Official development assistance |
| PACS | Payment for agrobiodiversity conservation services |
| PBS | Program for Biosafety Systems |
| PES | Payments for ecosystem services |
| PIM | CGIAR Research Program on Policies, Institutions, and Markets |
| R4D | Research for development |
| R&D | Research and development |
| RePEc | Research papers in economics |
| SACCAR | Southern Africa Center for Cooperation in Agricultural Research |
| SADC | Southern African Development Community |
| SGRP | System-wide Genetic Resources Programme |
| SRF | Strategy results framework |
| SROs | Subregional organizations |
| SSA | Sub-Saharan Africa |
| STI | Science, technology, and innovation |
| ToR | Terms of reference |
| USAID | US Agency for International Development |

# ABSTRACT

Science, technology, and innovation (STI) policy research can be defined as "research to understand the financial, regulatory, institutional, and organizational management of the process of scientific discovery, technology development, and delivery." The scope of STI policy research extends across the research and development (R&D) spectrum and entails a range of policy change mechanisms.

The International Food Policy Research Institute (IFPRI) has undertaken research programs on agricultural STI policy since 1995. This study assesses the impact of this body of research outputs and support services in terms of three complementary analyses: (1) an evaluation of the potential impact of the complete body of research using implicit or explicit impact pathways, (2) two case studies that assess the actual impact of particular research outputs, and (3) a more traditional bibliometric analysis. Movement along the impact pathway, in turn, requires different types of research products—evolving from problem framing to methodology development, then to case studies, and finally to context-specific policy recommendations—all within the logical stages of the impact pathway. How far IFPRI operates along this impact pathway produces a basic tension between the CGIAR's mandate to produce international public goods (IPGs) and the increasing focus on accountability through impact in the use of international public funds.

This study explores this tension along very different impact pathways that have been pursued by IFPRI researchers in STI policy, especially within the context of the case studies on regional research and genetic resources. The study finds basic trade-offs in a research program exploring emerging issues at the cusp of agricultural science and technology, and one designed around a clear impact orientation. How far should IFPRI operate across the R&D spectrum at the expense of developing new areas of STI policy research?

# 1. AN OVERVIEW OF STI POLICY RESEARCH AT IFPRI

STI research is in many ways central to both IFPRI's mission of providing "research-based policy solutions that sustainably reduce poverty and end hunger and malnutrition" and its role within the CGIAR. As IFPRI's recent strategy notes, "Within CGIAR, IFPRI is well positioned to provide leadership in economic and social-science research linked to policymaking and institutional arrangements and integrating it with (1) biological research in nutrition and public health and (2) biophysical research in crop and animal breeding, water, soil, and climate" (IFPRI 2013, 3). IFPRI has maintained an STI policy research program since 1995, which has evolved significantly since then.

The potential scope of STI policy research is dauntingly large, yet there is no agreed framework for prioritizing this research. As one of the CGIAR's 15 research centers, IFPRI leads in defining policy research in what is the core area of the CGIAR system's work. Bioversity International and the Center for International Forestry Research (CIFOR) also focus on science policy, but in very specific areas—genetic diversity and forestry and associated areas of natural resource management (NRM). The work of almost all of the other CGIAR centers has a policy dimension, but it is complementary to CGIAR's mandate. The CGIAR Research Program on Policies, Institutions, and Markets (PIM) provides a platform for linkage of policy work across 14 of the 15 centers, and science policy and innovation is a programmatic cluster.

Over the last two decades, IFPRI has added a range of thematic focus areas under what is broadly the STI banner. This study focuses on only one research program area within the overall STI portfolio—Global Research Program 1 (GRP1)—and assesses the impact of that program during 1995–2012. Given the time period under consideration, this study first reviews the changes in the thematic structure of STI policy research at IFPRI. The second chapter presents the methodology used for the study; chapter 3 evaluates the full GRP1 research agenda, exploring its potential for impact; chapter 4 presents two case studies that evaluate actual impact; chapter 5 uses a bibliometric assessment of the use of GRP1 research publications; chapter 6 evaluates capacity building and partnerships; and chapter 7 presents the conclusions. To begin, it is useful to locate GRP1 within the overall STI portfolio, as it provides background and context to the evolving research agenda of GRP1.

## Evolution of STI Policy Research at IFPRI

STI policy research can be defined as "research to understand the financial, regulatory, institutional and organizational management of the process of scientific discovery, technology development, and delivery." The scope of STI policy research extends across the R&D spectrum and entails a range of policy change mechanisms. The intent is that these policy changes will both improve the effectiveness and efficiency of the R&D process, and thereby help to achieve the strategic objectives of IFPRI—as well as the CGIAR more broadly—by reducing poverty, particularly rural poverty, improving food security, and strengthening the sustainable management of the natural resource base. More recently, improved nutrition has also become a strategic objective for agricultural research within CGIAR, with IFPRI leading in this area.

The knowledge and products produced by agricultural research can have direct impacts on food security, nutrition, and NRM, and research processes can be designed to target such impacts. IFPRI has developed the databases and analytical methods for such targeting. However, how to best design research processes to have direct impacts on rural poverty is less clear (as will be discussed in Chapter 3), although IFPRI research has widely explored indirect effects through growth linkages.

From 1995 to the present, the research agenda for STI policy has been a process of accretion of program components. Research is organized within IFPRI by division, and then within divisions by research themes. As IFPRI's 2006 External Program Management Review (EPMR) noted, research "themes appear to be more a device for placing all IFPRI research on the same level of priority rather than a tool for choosing among alternative research projects" (CGIAR Science Council Secretariat 2006a, 10). The progressive addition of research components within the STI policy area was motivated more by serendipity than by a clear sense of research priorities within the scope of the definition above. In particular, STI policy research evolved largely through a process of joint work with the International Service for National Agricultural Research (ISNAR) and successive migration of ISNAR program components to IFPRI.

In 1994, Phil Pardey moved from ISNAR to IFPRI and established the agricultural research policy program, which became GRP1 within IFPRI's Environment and Production Technology Division (EPTD) (discussed in more detail in Chapter 3). That same year, *Science under Scarcity* was published, which became the seminal text on resource allocation in agricultural research (Alston, Norton, and Pardey 1995). In 2001, IFPRI's Agricultural Science and Technology Indicators (ASTI) program was created with funding from the World Bank and was built on ISNAR's original Agricultural Research Indicators database. Then in 2004, ISNAR was closed; its program components migrated to IFPRI, with most of them moving to the newly created ISNAR Division; and ASTI was moved to this division as a separate research theme. The early work on agricultural innovation systems at IFPRI was located in this division and built on very early work at ISNAR. The other STI components were organized around research organization and management and capacity strengthening (see Figure 1 on the evolution of STI research themes. At the same time, the Program for Biosafety Systems, which was funded by the United States Agency for International Development (USAID) and started at ISNAR in 2003, was placed in EPTD.

Another of the STI research themes is the Spatial Analysis Group (GRPSP2), which was established in 2003 and grew from the incorporation of spatial analysis into resource allocation models in GRP1. In 2006, GRPSP2 evolved into HarvestChoice with support from the Bill & Melinda Gates Foundation.

Another cluster of work on genetic conservation policies evolved initially from IFPRI's early participation in 1994 in the System-wide Genetic Resources Programme (SGRP), which was led by the International Plant Genetic Resources Institute (IPGRI)—now Bioversity International. This work focused on ex situ conservation of genetic resources and is dealt with in some detail in later sections of this paper. The research theme then evolved into work on in situ conservation through the creation of a joint staff position between IFPRI and IPGRI/Bioversity International in 2002–2005. IFPRI provided the economic research capability in support of policy research at this sister, CGIAR center.

This process of program accretion and the associated dispersal of STI research themes across different divisions led directly to the issue of program coherence. The 2006 EPMR framed the issue as involving "not broad strategy, but rather matters of prioritization and of operational tactics for carrying out IFPRI's highly ambitious agenda with maximum effectiveness" (CGIAR Science Council Secretariat 2006a, 9). All work on STI policy, including ASTI and innovation systems, was brought together in EPTD during 2010 after the ISNAR Division was closed. Thus, all work on STI policy now reports to a single division director.

A comprehensive STI research strategy was produced in 2011, which was then integrated into the new IFPRI strategy of 2013. While this integration brought more coherence to the program, this recent period of STI policy research lies outside the purview of this impact study, which focuses on GRP1 from 1995 to 2012. Thus, a subsidiary question for this study is whether the organizational dispersal of research themes reduced the possible synergies between GRP1 and other STI research themes and, therefore, reduced the overall effectiveness of the research conducted.[1]

A final observation is that a growing generation of services complements the products (research publications) generated by the STI research program. The service function comes with investment in what might be termed long-term public goods, which require support to ensure access to and use of these public goods, as well as to keep the data current. Examples are the databases that form the foundation of HarvestChoice and ASTI, or the continuing investment in such methods such as the DREAM (Dynamic Research EvaluAtion for Management) program for returns to research investment or the spatial crop distribution models that are a component of HarvestChoice. The Program for Biosafety Systems provides technical support on biosafety standards in focus countries. In many ways, this investment in services is a key to facilitating impact and could be considered to be a necessary part of production of IPGs.

## Evolution of GRP1

GRP1 has formed the nucleus around which the overall STI program has evolved and has been the vehicle for shifting into new research themes within the STI portfolio. As Figure 1 shows, the research foci of the GRP1 program have varied over the period under review. The relative focus and critical mass of work have primarily been set by the research interests and background of the program director (who has changed three times over the period under review), who in turn is selected by the EPTD director and the IFPRI director general. Thus, the research outputs of the program tend to cluster around particular topics at different periods.

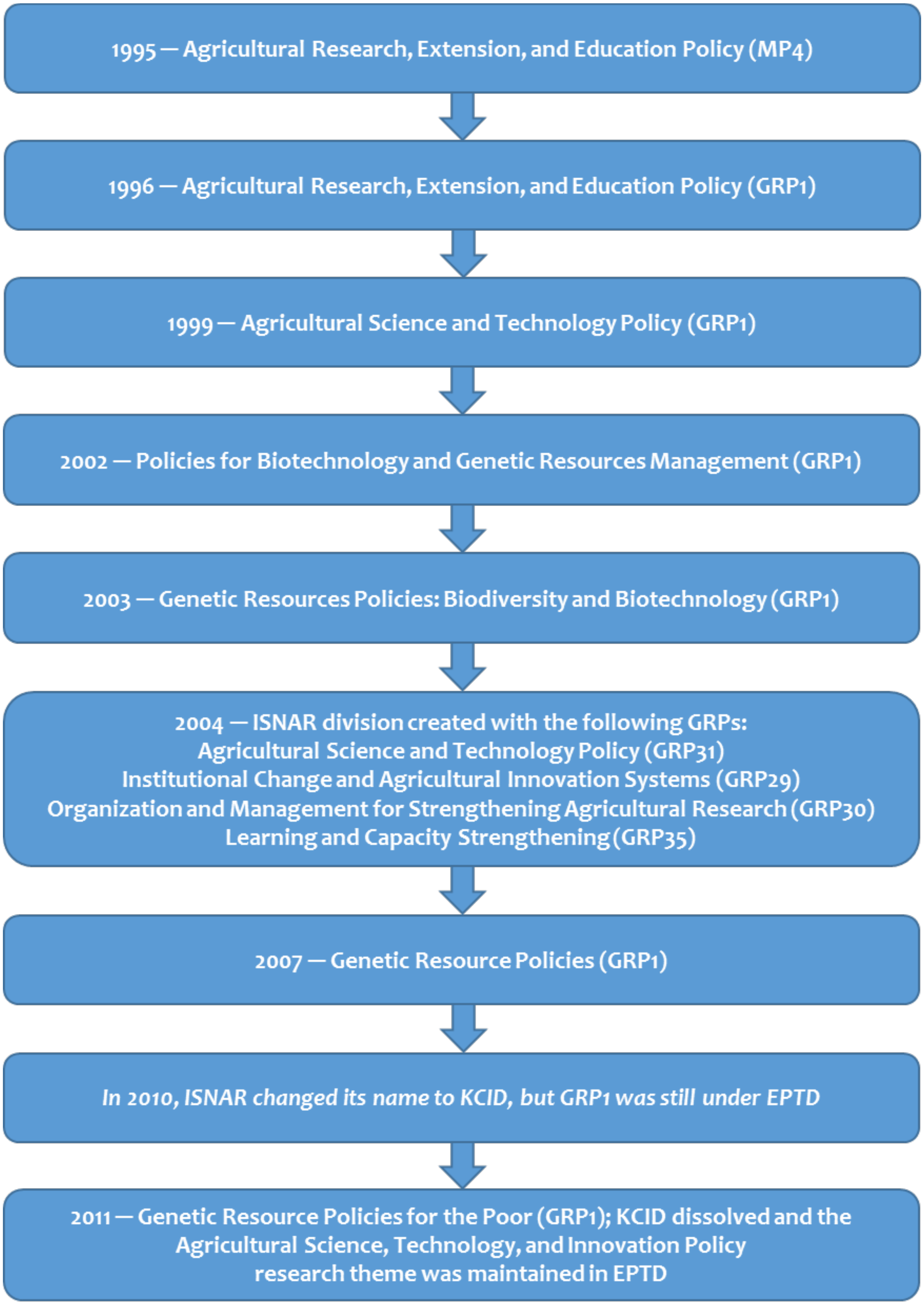
GRP1 can be analyzed in terms of three principal research areas:

1. Priority Setting and Returns to Agricultural Research;
2. Genetic Resources, Agrobiodiversity and Biotechnology; and
3. Agricultural Innovation Systems.

From the perspective of impact assessment, the research agenda evolved from a broad area of policy research with no particular target institutions that might use the research, to a much more focused area of policy research with the potential of linking the research outputs to specific institutions that might use them. Finally, the focus expanded again to a relatively broad domain of research and potential users. For IFPRI, the question of how focused its research should be to ensure a significant level of use of the research findings and, in turn, potential positive impact is interesting. However, such focus potentially comes at the expense of exploring other, more critical themes where IFPRI can innovate in terms of methods and framing of the research topic.

[1] The organization of research into themes balanced funding prospects with research program coherence. The research themes were relatively autonomous units, generally had their own funding sources, and had rather narrow, discrete strategies. STI is a good example of what was a relatively diffuse program structure, where there was a potential loss of strategic coherence.

**Figure 1. Evolution of STI policy research themes**



The program changes as reflected in the shifting titles of GRP1 capture the dominant thrust of the research at that time, but do not reflect either the entire gamut of research themes or the beginning exploration of a research theme that would evolve into a principal focus. Genetic resources is one such example, where it was a minor research exploration in 1996, which became the dominant program thrust by 2002. The program evolution was thus not as linear as reflected in Figure 1.

# 2. ASSESSING THE IMPACT OF POLICY RESEARCH

This study evaluates the impact of STI policy research over the period 1995–2012. The study is organized around three basic questions:

1. How is policy research in the area of science, technology, and innovation translated into impact?
2. Is a chain of research from discovery to finely targeted application necessary to optimize the potential for impact?
3. If so, are there clearly defined impact pathways through which policy research is prioritized and capacity building and communication are simultaneously developed?

Chapters 3 and 4 contain the analytical assessment of the complete output of research publications in relation to the research strategies developed in each of the three research phases. Assessment of the research output is supplemented by drawing on unpublished memos and reports and interviews with key stakeholders. The research output in each of these phases is assessed in terms of potential impact against either an explicit or an implicit impact pathway, which provides a framework for assessing the three questions above. Chapter 4 selects two case studies to evaluate actual impact, where impact is defined as "a clear contribution to a policy or institutional change." Chapter 5 uses a bibliometric evaluation to assess the influence of IFPRI's research on the wider policy research community, and surveys the methodology used for assessing the impacts of policy research.

During the period under review, the relative weight CGIAR gave to ensuring positive impact on development objectives versus the production of IPGs in the design of the research portfolio significantly shifted. In the early part of the period up to the CGIAR reform in 2008, the CGIAR Science Council, which oversaw the research conducted by the CGIAR centers, evaluated the research portfolio on the basis of three principal criteria: "(i) the probability of impact, (ii) the international public goods nature of the research, and (iii) the comparative advantage of the CGIAR to undertake the research" (CGIAR Science Council Secretariat 2006b, v). The phrasing "probability of impact" is important in the sense that it was recognized that a focus on international public goods (IPGs) could not guarantee impact on development objectives. In a paper on the subject the Science Council noted that "there may not necessarily be a perfect congruence between the humanitarian goals of the CGIAR and the IPG imperative" (CGIAR Science Council Secretariat 2006b, 20).

Also during the review period, official development assistance (ODA) was increasingly being shifted to IPGs, particularly in the environmental and health sectors. However, agroecological and socioeconomic context was much more important to the ability to achieve impact with agricultural IPGs, which is the basis of the trade-off between these two criteria. The Millennium Development Goals (MDGs), particularly the poverty objective, and the increasing focus on accountability very much shifted the relative importance of the two criteria. This was recognized by the Science Council in the following quote: "The production of national and local public goods is clearly of less interest to the CGIAR, except in so far as enhancing national capacities through training and institutional strengthening help countries to absorb and benefit from IPGs. Assessment and attribution of the socioeconomic impacts of local and national public goods are arguably easier than is the case for IPGs. In an era of increased accountability this aspect has no doubt influenced the priorities of the centers away from IPGs" (CGIAR Science Council Secretariat 2006b, 5). The CGIAR reform and the emphasis on results-based management have made that shift explicit.

This shift in criteria for assessing and organizing research is important for this study, as research within the STI program went from being organized according to IPGs to being organized with a far greater orientation toward direct impact. The STI team has framed the issue as research on "global public goods that have explicitly defined and objectively verifiable development impact."[2] For CGIAR centers, the problem is manifested in how far across the research-to-development continuum to structure programs and, therefore, the mix of international, regional, and national public goods, if not the design of delivery pathways for research outputs. Addressing this problem is reflected in an expanding number of regional and country offices by CGIAR centers. For example, in 2004, IFPRI decentralized its research programs through a combination of outposting staff to newly established regional offices, by expanding the number of temporary country-based project offices, as well as establishing a handful of country strategy support programs (CSSPs). While the CSSPs accounted for a minority of outposted staff, they offered the opportunity to focus on institutional context within the country, capacity development, and, in essence, adaptive policy research.

This tension between IPGs and development impact is especially prominent in policy research, particularly in the STI area. By its very nature, science is dynamic, requiring novel regulatory and institutional arrangements. Policy research in such a dynamic field (as discussed in the next two chapters) requires a conceptual and analytical framing of the problem, development of methods and critical databases, and tracking of developments in the field—in essence, IPGs. However, actual policy changes depend on context and require much more granular research specific to the agricultural economy and institutional arrangements existing in a particular country—that is, research essential to achieving actual impact that, in turn, depends on sufficient adaptive, policy research capacity in the country. The literature on transitioning policy research into use suggests that impact pathways are highly contextualized, as the small absolute benefits suggest. The relatively limited set of studies that has measured impact posits that "although internal rates of return for successful policy research are as high as or higher than for successful genetic improvement research, estimated net present values appear to be smaller" (Walker, Ryan, and Kelley 2010, 1459). How, then, does IFPRI balance the production of IPGs, while maintaining an impact orientation for its research?

## Defining Impact Pathways for Policy Research in STI

IFPRI defines the goal of its generic impact pathways as to "generate and maximize the uptake of a broad range of institutional research products (*outputs*), contributing to changes in policies, programs, and investments (*outcomes*) that can ultimately lead to improved food and nutrition security, poverty reduction, and sustainable natural-resource management (*impact*)" (IFPRI 2013, 24). A significant body of literature supports the contribution that technical change makes to overall growth in the agriculture sector, as well as to poverty reduction, although the latter effects are heterogeneous and dependent on structural features of the agricultural economy. That evidence has justified investment in agricultural science and research that supports growth in agricultural productivity. Policies that support decisionmaking in the area of science and agricultural research are principally framed around investment strategies and institutional innovations.

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[2] Reviewer comments.

Research questions central to such policy research tend to be framed around what to invest in (research priorities), how much to invest (balancing scale and scope), and who makes the decision (the budgetary process). A hierarchical structure to the investment problem in the public sector determines the "who"—that is, which policymaker makes a particular investment decision. The first level of decisionmaking focuses on how the agricultural budget is allocated between research and other areas; this is a negotiated process between the treasury and the ministry of agriculture. The next level of investment decisionmaking focuses on how the R&D budget is allocated—namely, research priorities. Over the period under review, there has been a shift from the implementers of the scientific research making these allocation decisions to the "funders." The "who" question has not been a particular focus of IFPRI STI research, nor does it have an extensive body of literature; however, a research paper on the budgetary process in Ghana gives insight into the important role it plays in the policy process (Johnson 2013).

Thus, a generic impact pathway for STI policy research influencing investment decisions is whether research outputs are used by varying levels of decisionmakers to achieve efficiency gains in resource allocation that, in turn, improve the generation and delivery of technologies adopted by farmers. Widespread adoption then leads to the potential impacts on the three strategic objectives. While this is a long and more tenuous impact pathway than, for example, the impact of improved crop varieties, the key is to demonstrate that there has been a significant change in decisionmaking: the research outputs generate substantive outcomes—specifically, policy changes.

Research outputs in the STI theme are of different types and have varying potential for directly influencing decisionmaking versus contributing more generally to knowledge generation and IPGs. Purely methodological papers and review papers fall in the latter category. What might be called framing papers—that is, research that innovatively frames a problem area and suggests an analytical framework to study the problem—can be seen as an initial step in developing a decision framework for the problem area. The next steps are purely analytical pieces that represent case studies in specific contexts and that suggests the scope of the policy choices. These, in turn, frame country-specific research that provides actionable policy advice. While country-specific research has the highest potential for producing outcomes, all four types are necessary and *suggest* a critical mass of work, appropriately sequenced, to move policy research into use.

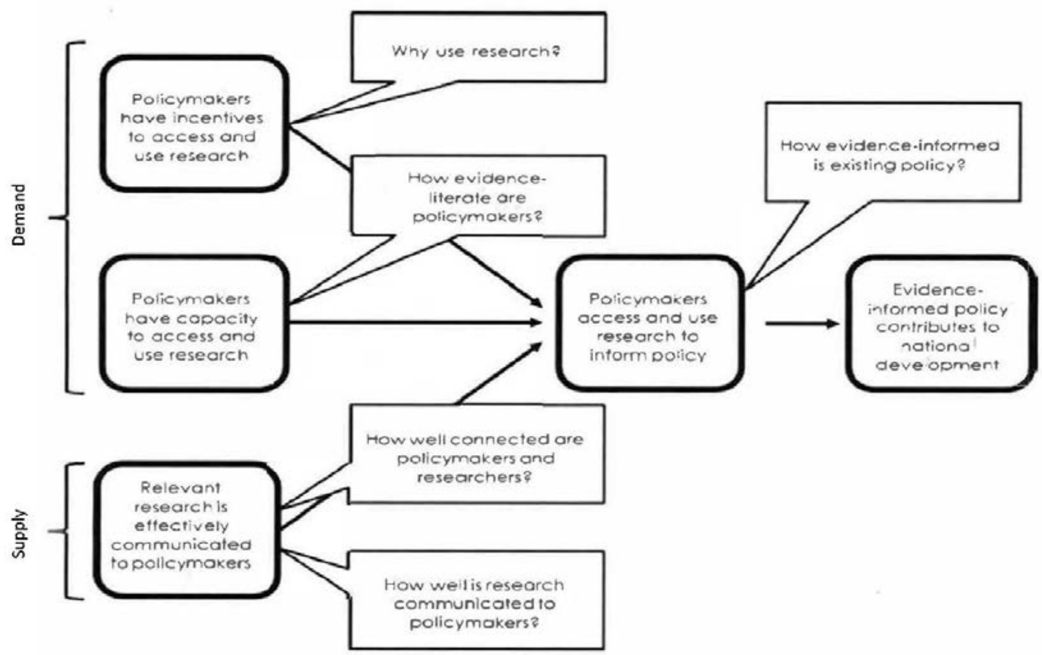
The range of STI outputs follows this pattern—namely, a complement of different types of research reports within a particular thematic area.[3] However, there usually remains a gap in terms of what is increasingly called the "last mile" in getting products to end users. In the policy arena, this normally implies the development of specific policy advice for a priority problem directed to a particular set of policy decisionmakers. Who does the research on the "last mile" policy prescriptions and how that interfaces with IFPRI's capacity building, country programs, and partnerships are issues in designing policy research with an impact orientation.

Compared with the impact stage, the outcome stage is arguably the most informative in terms of understanding impact pathways for STI policy research. Studying the outcome stage is

[3] In addition to the different types of STI research conducted, IFPRI in general prepares different types of research outputs (reports, working papers, briefs, journal articles, books and book chapters, etc.) and accompanies those with (1) presentations in workshops, seminars, and conferences designed for audiences ranging from academic to operational; and (2) discussions with policymakers and other actors involved in decisionmaking about public policy. These outreach activities are brought together under an evolving communications strategy, one of the four pillars in IFPRI's 2013–2018 strategy.

analogous to focusing on farmer adoption in understanding the relevance of improved technologies. A limited but increasing number of publications analyze the policy research-into-use problem, and argue that this area of research is legitimate in itself for evidence-based policy (Prewitt, Schwandt, and Straf 2012; Newman, et al. 2013; and Carden 2009). Increased emphasis on this part of the impact pathway moves the research into the domain of political economy and operations research, as well as the provision of service functions, as mentioned in Chapter 1 above.[4] Figure 2 outlines a very generic impact pathway for policy research-into-use and suggests that the other three legs of IFPRI's strategy-into-action framework—partnerships, communications, and capacity strengthening—are in themselves a context-specific, integrated strategy for ensuring the effective use of research outputs. Linking the supply and demand for policy research is, in turn, framed within the balancing of production of IPGs and ensuring the impact of policy research.

**Figure 2. A generic impact pathway for policy research**




Source: Newman et al. (2013).

## Impact Assessment Methodology

The methodological problem is how to attribute policy changes in the STI field to IFPRI's research outputs. The difficulty lies in the significant variation in theme and type of research product across the published articles. Moreover, the focus on IPGs results in a lack of clarity on either the specific

[4] The Program for Biosafety Systems (PBS) Program focuses on change in biosafety legislation, regulation, and implementation in focus countries and as such, is primarily organized around "last mile" issues. An impact study concluded that "PBS is serving a largely facilitative role to allow the regulatory process to develop within countries. This is appropriate but requires considerable depth of thought to determine the appropriate strategic approach to facilitate the process." Defining alternative pathways for regulatory change suggests an operational research agenda (Adams, Shelton, and Wolt 2008).

policies that are addressed by the articles or the policy actors whose behavior is the target for change. The attribution problem is much more varied and context dependent than, for example, the impact assessment of the ASTI database (Norton 2010). For the latter, a Bayesian approach could be used to evaluate the value of the data in policy decisions, in particular, investment in agricultural research. The STI research outputs are more varied in scope and types of policy recommendations. This tends to bias the choice of methodology toward more qualitative methods.

The methodology developed for this impact assessment is based on methods in the evaluation literature. As stated in the first sentence of this section, the focus is on attributing policy changes—that is, outcomes—to research publications. This focus introduces an immediate problem of matching method to the problem. As White (2010) notes, "…the best available method depends on the nature of the intervention being evaluated: is it a small ***n*** or a large ***n*** intervention? Here ***n*** refers to the unit of assignment of the intervention, for example, households, firms, schools, communities, districts, or Ministries" (White 2010, 155). As noted above, the ***n*** for policy research tends to be small, given that the unit of assignment tends to be national agricultural research institutes (NARIs) or ministries of agriculture, and in many cases is just one. In the evaluation literature, this moves the analytical method to theory-based approaches, where there is a prior specification of how the intervention is designed to achieve its projected impact objectives. The CGIAR has adopted these approaches in the design and monitoring of the CGIAR research programs (CRPs) (ISPC 2012), primarily as a means of reporting on development outcomes achieved from the investment in the research programs. As White notes, "a theory-based approach provides a framework for an evaluation. It still needs an analytical approach to determine if outcomes have changed as a result of the intervention" (White 2010, 161). "For small, and often medium sized ***n***, qualitative approaches are the best available methodology" (White 2010, 155).

The methodology adopted in this study has three parts: an evaluation of the potential for impact, an evaluation of actual impact, and an assessment of the influence of the research on the larger policy research community. The evaluation of potential impact assesses the research outputs in each of the three principal research phases against an explicit impact pathway, if found in the strategy, or against an implicit impact pathway developed by this reviewer. This analysis of potential impact assesses the different steps or stages necessary to reach a policy outcome, as discussed in the last section from problem framing, methodology development, and case studies to context-specific policy recommendations within the logical stages of the impact pathway. This qualitative assessment evaluates the research outputs produced in each theme in terms of the coverage of the necessary topics in the impact pathway and the balance between IPGs and actionable policy recommendations. The analysis provides one type of framework for assessing priorities for policy research in terms of the potential for generating research outcomes.

Section 4 assesses actual impact. It selects two case studies on the basis of expected use of the research outputs, and evaluates them in terms of whether, how, and who used the research outputs. The first case evaluates the research on ex situ and in situ conservation of genetic resources. The case of ex situ conservation involves a single research output, while that of in situ conservation involves a body of work across several topics. The second case assesses the outcomes produced by a single research study on strategic planning and priority setting in a subregional research organization, the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). Causality, in the sense of the research outputs being attributed to the policy outcome, is defined as either sole attribution (the research output was the sole factor causing the change in policy) or partial attribution (the research was one among several of the necessary factors that contributed to the policy change).[5] The key-informant approach is the basic methodology used in attributing policy change to research because of the small ***n*** problem, and has been the basic method the CGIAR has used in assessing the impact of policy research (Walker, et al. 2010). This approach includes both a review of supporting documentation and interviews with key informants who participated in the decisionmaking leading up to the policy change.

[5] White (2010) makes this distinction and distinguishes partial attribution from contribution.

# 3. ASSESSING AN EVOLVING RESEARCH AGENDA

## The First Phase

The early foundations of IFPRI's STI program derive from ISNAR's policy program and involved at least two migrations of staff and programs to IFPRI, as discussed in Chapter 1 above. The first migration in 1995 was responsible for the initial research agenda of the STI program. The initial focus of IFPRI's STI program was on understanding the returns to agricultural research as justification for increasing funding, particularly public investment. This involved (1) standardizing methods—the basic reference being *Science under Scarcity* (Alston, Norton, and Pardey 1995); (2) building essential databases on agricultural research systems—the ASTI database and reports; and (3) extending the evaluation of agricultural research, which was organized primarily around priority setting and the associated efficiency gains in allocation of financial resources, and also around improved evaluation techniques, with the extension of the objectives of agricultural research into distributional and environmental outcomes (IFPRI 1996). The explicit impact pathway was that these techniques would be used in NARIs in resource allocation and improved economic efficiency.

The objectives of this phase of the STI program were set out as research themes, as follows:

Theme 1: Measure and monitor the global pattern of investments in agricultural R&D and provide policy interpretations of these developments for national and international decisionmakers (through the ASTI database).

Theme 2: Continue development of systematic, economic approaches to evaluating and setting priorities for agricultural research, initiate work on the evaluation of social science research, and to provide practical decision aids and assistance in applying these approaches to inform strategic research priority decisions.

Theme 3: Gain a more complete understanding of the productivity, distributional, and environmental consequences of agricultural research and other public-sector investments targeted to the agriculture sector.

Theme 4: Explore alternative policies regarding the economics of financing, organizing, and managing agricultural R&D, and broaden the focus to include other publicly provided services, such as agricultural extension and education.

Theme 5: Undertake a program of research on agricultural genetic resource policies, with initial emphasis on the economic value and use of genetic resources under alternative intellectual property regimes (IFPRI 1996).

Priority setting in agricultural research systems during this period at the end of the 1990s was seen as a principal means of ensuring the effectiveness of investment in agricultural research. IFPRI's preeminence in this area spilled over into use of these methods within the CGIAR, particularly in the area of ex post and ex ante impact assessment. IFPRI extended these methods through the use of geographic information system (GIS) to capture the effects of agroecological variation on the response of agricultural technologies, the estimation of technological spillovers, and the development of IFPRI's DREAM estimation platform.

However, during the next decade, the potential impacts in terms of greater efficiency in allocating scarce resources invested in agricultural research were highly constrained as a result of a structural change in the funding of agricultural research. Priority setting lost its utility, with a fundamental shift of investors to competitive grant modalities and project-based funding of agricultural research. This shift from the implementers to the investors deciding on research priorities obviated the need for priority setting, except at the level of structuring competitive grant programs, which were usually designed based on other criteria.

As the CGIAR moved from core funding to project-based funding, overall research strategy remained important, but priorities were less of a factor in research programming. With the changing institutional context for funding agricultural research, which was documented in the developing countries by GRP1 (Alston, Pardey, and Roseboom 1998), the work on priority setting shifted to applications within the subregional organizations (SROs) in Africa (SSA) (discussed in Chapter 4 in one of the case studies). The methods focused on priorities across commodities and R&D domains and primarily as input into strategy development for the organization.

The complement to the work on priority setting was a review of returns to agricultural research (Alston et al. 2000). The analysis of 292 studies found that the annual returns to agricultural research were very high, generally 20–80 percent. These rates of return were used to argue that there was a persistent underinvestment in agricultural research. From an impact perspective, this work had little apparent effect on closing this underinvestment gap. Subsequent work suggested that there was a persistent bias to overestimate these rates of return, and that this may have produced some skepticism about the value of these data in investment decisions (Alston et al. 2011). On the other hand, from an impact perspective on research-into-use, there is a lack of understanding of the role of these studies in influencing investment decisions in agricultural research. Certainly there is a demand from investors for such impact studies, but it could be argued that these studies are primarily used to justify existing levels of investment in budgetary discussions. There is little data to suggest that such studies are used in either increasing these investments or changing their allocation.

The 2001 GRP1 strategy outlined a critical research area as follows: "The relationships between agricultural productivity growth, poverty and the environment are complex and difficult to disentangle. The effect science and technology policies have on these linkages is a unifying theme across all GRP1's work. One view is that agricultural R&D policies that maximize long-run growth might have the biggest payoff in terms of poverty reduction and, perhaps as a consequence, overall environmental effects. Another is that R&D policies should seek to maximize short- to medium-term direct benefits to the poor and improvements to the environmental resource base on which they depend, acknowledging that this strategy can often be less effective at achieving overall growth. The difficult challenge facing those who must make appropriate policy choices, is to obtain some clearer notion of the tradeoffs involved, both now and in the future" (IFPRI 2001, 1–2).

This is a central issue for investment strategies, for organization of research and design of research strategies, and for performance monitoring of agricultural research. The topic drew on earlier research on the returns to government investment in India (Fan, Hazell, and Thorat 1998), which demonstrated the dual impact on both poverty and productivity from investment in agricultural R&D. This is an important result. But how does it influence government, donor, and NARI investment decisions? How dependent was the result on the Indian context? Moreover, the question still remains of whether to focus on productivity objectives and assume that the poverty objectives will be addressed in market-based growth linkages or to attempt to incorporate both objectives in short- to medium-term agricultural research investment decisions with the potential for reduced efficiency gains.

A change in program leadership in 2002 when the GRP1 director left and a refocusing of program objectives resulted in this research question not being pursued. Yet, it remains a central question in the allocation of research resources, particularly within the CGIAR. The CGIAR move to results-based management emphasizes the direct achievement of development objectives and assumes that the answer to this question is to hold research programs accountable for direct impacts on the three strategic objectives of poverty, nutrition, and ecosystem services. Although this is a very complex research question requiring comparisons of actual direct benefits from program investments with computable general equilibrium (CGE) modeling, this decision by CGIAR could provide the case studies needed to begin addressing this question in some detail, with significant implications for how to hold agricultural research accountable.

Moreover, multiple objectives (poverty, environmental services, and more recently nutrition) would inform research investment decisions in the short to medium term. What this does is to locate research priority setting within a multiple-objective framework. The STI program did little work on priority setting within such a framework, and yet this would be the context for priority setting in CGIAR and for impact assessment more generally for agricultural research investment. This is a complex undertaking, and no other policy research institute has conducted sustained work in this area. Given IFPRI's work in systematizing priority setting and ex ante impact assessment based on efficiency criteria, the lack of extension into the multi-objective arena left a vacuum that is yet to be filled, as the discussion on priorities in CGIAR's recent Strategy and Results Framework (SRF)[6] would attest.

The parts of the program that continued were databases—namely, the ASTI database and the spatial databases under HarvestChoice for targeting agricultural research, and the subregional methodology for strategic priorities and targeting for the three African SROs. The databases are classic IPGs and continue to provide critical datasets that no other organization provides. Although funding these databases through project funding risks long-term continuity, few alternatives are currently available within the CGIAR.

The research program in this first stage of the STI policy program from 1994 to 2002 raises a central question of how to move from a well-articulated research agenda largely focused on the production of IPGs, to effective use of that research in policy decisionmaking, and then to impact. During this period, significant changes in institutional context affected demand for that research, particularly changes in how research was funded and how resource allocation decisions were made. Monitoring demand, which is difficult for an international organization like IFPRI, nevertheless is a necessary part of ensuring effective use of the research.

Efficient allocation of limited research resources is a central policy issue for international aid agencies, for developing-country governments, and for NARIs. However, the agenda has shifted from improved efficiency through ex ante priority setting to results-based management and demonstrating empirical outcomes from the existing research portfolio. The danger, however, is that evidence-based decisionmaking is given a back seat to merely measuring results (Shepherd et al. 2015). IFPRI has effectively established itself as a leader in this research area and continues to provide critical databases that support policy research and more effective investment decisions.

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[6] The CGIAR Consortium recently revised its Strategy and Results Framework. A key issue for funders to the CGIAR was how to use the SRF to allocate budgets to best achieve the three strategic goals of the CGIAR. There was no existing analytical framework that could be used to provide such priority setting across the three strategic goals.

However, IFPRI has left a research agenda that remains unfulfilled and for which there is apparent demand—at least within the CGIAR. This has left a vacuum in priority setting and the efficient allocation of research resources that persists to the present.[7]

## The Second Phase

The bioscience revolution dominated the next phase of STI policy research. The rapid advances in molecular biology and the declining costs in applying these techniques together with the patenting of both genes and processes, spawned (1) the development of the large bioscience multinational corporations—six firms dominate in the biotech, plant breeding, and agrochemical world market; (2) the move by the public sector out of plant breeding in the North; and (3) the adoption of transgenic varieties by the large countries in the South (primarily Argentina, Brazil, China, and more cautiously, India). For the smaller countries in the South and for vegetatively propagated and self-pollinated food crops, the CGIAR became the locus for the application of these techniques in breeding programs, in terms of both marker-assisted selection and transgenics. The patenting of genes and associated use of intellectual property rights (IPRs) gave impetus to the approval of the Convention on Biological Diversity in 1993; the negotiation and entering into force of the International Treaty on Plant Genetic Resources in 2004; and the subsequent creation of the Global Crop Diversity Trust in 2006, which precipitated significant changes in how the crop gene banks of the CGIAR centers were financed and managed. At the same time, genomics opened the possibility of more effective characterization and use of the genetic diversity in these gene banks, and spotlighted the conservation, use, and deployment of genetic diversity in managing food systems. This was a clear area within STI for policy research in a rapidly changing technical and institutional context.

The research agenda surrounding agrobiodiversity, genetic resources, and biotechnology is in one sense more targeted than the previous phase in terms of the institutions and organizations that could benefit from policy research and their implicit policy agenda. On the other hand, the issues present a relatively broad scope for potential research, and the agenda shifted significantly over the period 2001–2009, when STI had a focus on these topics. The initial focus, which originated in the previous phase, was on IPRs, the impact on trade, and the changing regulatory context for both international trade and researcher access to patented products and processes—namely, freedom to operate.[8] However, these issues affected principally the large developing countries, particularly exporting countries in Latin America that produced the crops where genetically-modified (GM) varieties were principally used, and had invested in developing a biotechnology research capacity.

A revised strategy for GRP1 was produced in 2004 (Smale and Koo 2004). A research program was laid out in two areas: crop biodiversity and biotechnology. The research agendas in each of the areas were relatively independent. Genetic diversity focused on establishing the conditions for in situ conservation of genetic resources, while biotechnology and biosafety research was organized

[7] IFPRI continues to make a contribution to priority setting, albeit not explicitly through the STI program. IFPRI's recent and ongoing work being conducted under the Global Futures and Strategic Foresight program (see http://globalfutures.cgiar.org/) is assisting the CGIAR and its partners with setting priorities, although more *within* defined research programs than *across* research programs. Evidence-based decisionmaking based on ex ante analyses like those produced by the Global Futures and Strategic Foresight program have been given a back seat to merely measuring results, with an increased focus on accountability.

[8] See an initial paper on developing a research strategy in this area (Wright 1996).

around transgenics for smallholders—essentially done through case studies—and constraints on smallholder access to this new technology. The research objectives were specified as follows:

(1) "where does conserving biodiversity on farms make economic sense because the resources are likely to be valuable to future society as well as the farmers who manage them today?

(2) which crop biotechnologies benefit the poor while incurring tolerable costs in health and biodiversity risks?

Once promising candidates have been identified through empirical research, we can ask which policy mechanisms and investments.

(3) convey incentives for farmers to continue managing biologically diverse crop genetic resources in key locations?

(4) reduce impediments to the development and use of promising crop biotechnologies?" (Smale and Koo 2004)

The strategy recognized the sequencing of different types of research—the problem framing, the methodology development, and the case studies—in order to get to the development of policy frameworks in the two areas of genetic biodiversity (and its implications for in situ genetic conservation) and biotechnology, particularly the deployment of transgenic varieties. At this juncture in the development of the two areas, the strategy set out a research agenda rather than an explicit impact pathway. Again, research in the two areas was formulated independently of each other, but with a principal focus on understanding farmer decisionmaking as central to the research agenda.

To a significant extent, IFPRI's policy research on genetic resources and biotechnology built on the previous experience of the CGIAR's traditional crop improvement research. The added dimension was increasing productivity while maintaining or enhancing crop genetic diversity necessary for yield stability.[9] The policy research agenda was then framed in terms of how the changing international policy context for genetic resources and the changing foundations of crop improvement through molecular biology would affect productivity, especially in smallholder agriculture, and yield stability. The author's implicit impact pathway is presented in Figure 3. In the author's assessment, the policy research agenda for biotechnology with an impact orientation was defined by a 2004 assessment of GM variety pipelines for public-sector research in developing countries (Atanasovet al. 2004).[10] As the paper notes: "The public sector is a viable, but largely unproven, player in the bioengineering of local crops. While the participating institutes and scientists have developed many crop/phenotype combinations, which if found efficacious, and deemed safe, have not yet reached farmer's [sic] fields for trial and observation.… The fact that there are approximately 20 percent of the 209 events in various phases of confined testing indicates opportunities for advancement of public-sector research products. However, the longer the waiting period, the more likely the trait and/or germplasm becomes ineffective as disease pressures change and more productive varieties are released" (Smale and Koo 2004).

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[9] For a discussion of the relationship between increasing crop productivity and the variability in crop yield, see Smale and Hazell (2008).

[10] In terms of a broad framing of the potential role of crop biotechnology in developing countries, the following paper was more widely cited: Pinstrup-Andersen and Cohen (2000). This is an example where a general policy-framing paper has wider citation than a more specific paper focused on the critical steps for impact.

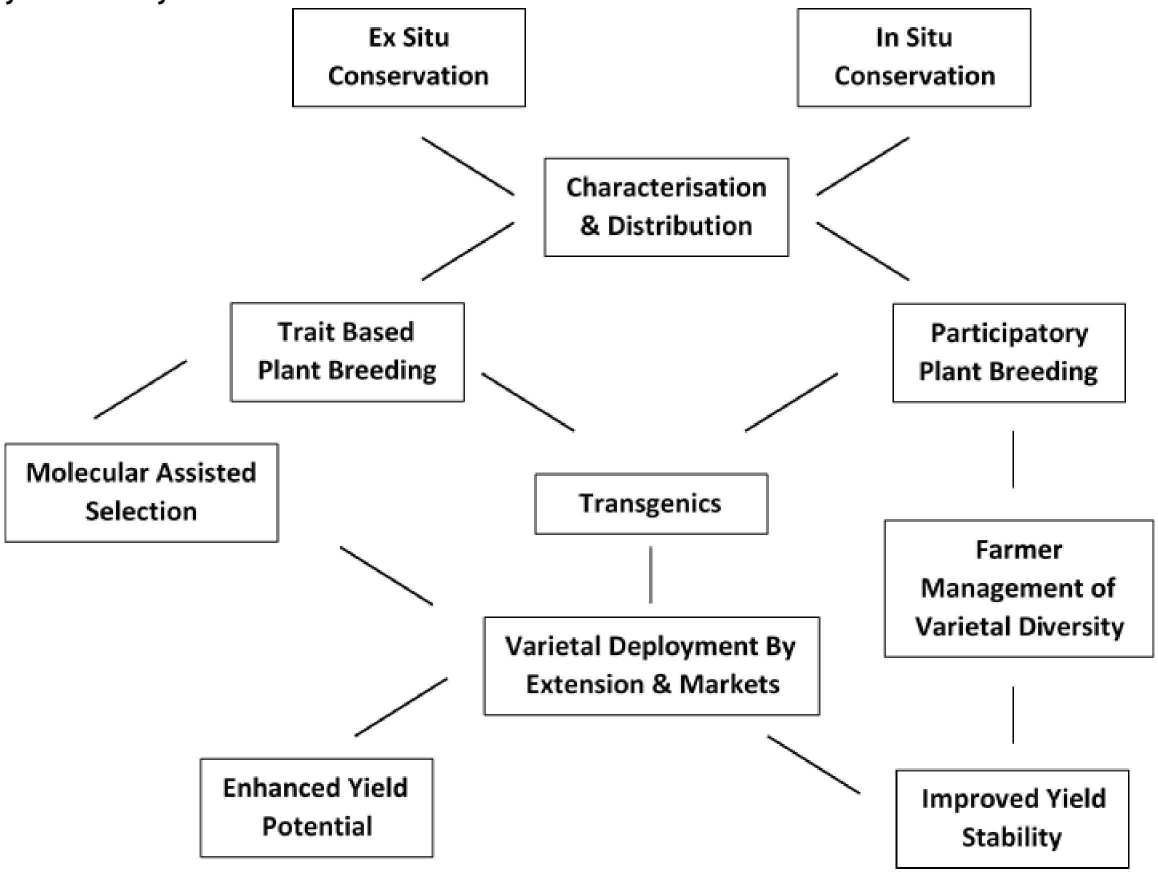
For smallholder producers in small developing countries, the public sector remained the potential source of transgenic approaches, especially for staple food crops other than maize. A decade after this report, there still has been only one release of a transgenic variety produced by the public sector (including the CGIAR) in small developing countries—Bt cotton has been released in a few countries, but these varieties derive from private-sector breeding programs.[11] Where, then, should IFPRI focus its research to achieve the desired impacts with biotechnology?

As Figure 3 suggests, there are a number of pathways to improve crop productivity while maintaining or enhancing crop genetic diversity. A strong crop-breeding capacity, whether at the national or regional level, is essential. Breeding strategies have diversified over the last decade and can involve traditional breeding augmented by marker-assisted selection (especially in terms of pyramiding genes for particular traits), participatory breeding, and varietal development through transgenics (often involving stacking of traits). The economic efficiency of these options, the impact on crop genetic diversity, the effectiveness in meeting farmers' demand for traits, and strategies for trait deployment were all potential research areas that could improve the cost-effectiveness of breeding strategies and optimize the adoption of improved varieties and the impact on genetic diversity, at least for nontransgenic approaches. During a period of rapid change in the underlying techniques of plant breeding, policy research in this area had the potential to significantly improve the potential impacts of varietal development. While IFPRI research explored several of these areas, it did not do so in a fully comprehensive framework, which would have resulted in the impact of policy research coming through more effective prioritization and more efficient organization of public-sector breeding programs.

IFPRI undertook a range of creative research papers that explored different breeding topics—for example, the work on returns to maintenance research in wheat breeding (Marasas, Smale, and Singh 2003), the distribution of trait preferences as input into banana breeding (Edmeades and Smale 2006), the relationship between varietal turnover and genetic diversity in wheat (Smale et al. 2008), and several papers on the potential role of participatory plant breeding in maintaining crop genetic diversity at the farm level. These papers framed a topic, used innovative analytical methodologies for the purposes of the topic, and generated first-order research findings. However, to be actionable within the context of breeding programs would require second-order research results, such as the relative priority between productivity and maintenance research in wheat breeding, or the distribution of farmers' trait preferences for bananas and matching those traits with the ecological adaptation of cultivars with particular combinations of traits. This problem of successive steps of refining impact orientation, in turn, raises the question of who should do such second-order research, and whether there is capacity in agricultural research institutes have the capacity to undertake such research (see the last section on partnerships and capacity strengthening).

[11] The International Service for the Acquisition of Agri-biotech Applications, Inc. (ISAAA) in its annual review of the use of crop biotechnology identifies more than 70 different products in various stages of testing; however, the only actual release is an eggplant variety in Bangladesh (James 2014).

**Figure 3. An implicit impact pathway connecting genetic resources to impacts on productivity and yield stability**




IFPRI's biotechnology policy research, because of its focus on smallholders and public-sector research, was oriented to ex ante impact assessment. Other research groups were undertaking ex post research in Argentina, China, India, and South Africa and were demonstrating significant returns, sufficient to justify investing in crop biotechnology, at least for large target areas (Klümper and Qaim 2014). IFPRI research focused on ensuring appropriate research methods (Smale et al. 2009), ex ante impact assessment of particular biotechnologies in specific countries, and trait demand by smallholder farmers. Most of the ex ante work dealt with a single trait, such as Bt cotton. The study on the farmers' demand for traits in bananas did evaluate the potential for transgenic approaches; there was a separate program just on biosafety.

Evaluation of this work in terms of potential impact, rather than just the quality of the research, revealed that the biotechnology research lacked target actors—namely, public-sector biotechnology programs. The decisionmaking would potentially revolve around which traits among many options yielded the highest benefits, how to decide whether to use traditional breeding or transgenic approaches,[12] what variety to transform in relation to both demand preferences and the spatial scope of its agroecological adaptation, and what market size justified the development and biosafety costs. The impact that transgenics would have on genetic diversity would have dovetailed

[12] For traits like virus resistance, both approaches are used, for example, with cassava mosaic virus or maize streak virus. Yet there has been no evaluation of the relative cost-effectiveness of the two approaches.

with the other research on crop genetic diversity.[13] Many of these various breeding decisions were made ad hoc, and there appeared to be potential for significant gains in economic efficiency in overall varietal improvement, whether within just biotechnology programs or overall crop improvement programs. Again, an impact orientation would have better focused both the research outputs and the associated partnerships.

## The Third Phase and Looking Forward

The work on agricultural innovation systems (AIS) was established with the creation of the ISNAR Division in 2004; with that, a research subtheme on Institutional Change and Agricultural Innovation Systems was initiated. In terms of the timeline, this work overlapped with the research on genetic resources and biotechnology, but was conducted in a different IFPRI division, and continued well after work on genetic resources significantly diminished. Although research in this area did not achieve the critical mass of research in genetic resources, it nevertheless provided some of the intellectual underpinnings for IFPRI's STI strategy developed in 2011 (IFPRI 2011). AIS articulated the research and innovation process in a conceptual framework very different from that used in the first phase and positioned IFPRI in a relatively new area of research, where theoretical approaches developed in the 1980s and 1990s based on innovation in the industry sector were only recently being applied in the agriculture sector. With a moderate research output, IFPRI was able to become one of the principal contributors to development of the AIS research agenda.

AIS is, as it is termed, a holistic systems framework. The ruling hypothesis is that there is not a fully functional AIS in developing countries. As the STI strategy states, research on an AIS might be "usefully characterized as the study of systemic failures resulting from the inability of agents engaged in the knowledge production process to learn about each other, identify areas of complementarity and synergy, build and sustain trust through interpersonal or organizational relationships, communicate and exchange ideas effectively, or respond to leadership" (IFPRI 2011, 10).

IFPRI did early work on developing a conceptual framework that helped frame the study of innovation systems (Spielman 2006a). This led to the development of methods to analyze the design of an AIS (Spielman 2006b; Spielman, Ekboir, and Davis 2009). An impact orientation would potentially involve diagnosing critical entry points in the overall innovation system, which would best improve its overall functionality and then undertake the needed research to improve that component. In this regard, IFPRI did innovative research on establishing a baseline to measure AIS functionality with application in Ethiopia and Vietnam (Spielman and Kelemework 2009). In terms of system design, the approach was to assume that each institutional component was critical, rather than to focus on the weakest link in the system chain. Much of the research analyzed individual organizations within an AIS—namely, public–private partnerships, agricultural extension, agricultural research, agricultural education, and networks—and most of this work was done from the perspective of SSA.[14] The usual problem framing was how the AIS framework would influence organizational models and efficiencies for these different entities. Some of these papers analyzed

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[13] A framework for this topic was developed in Qaim, Yarkin, and Zilberman (2005).

[14] For example, on extension, see Birner et al. (2009); on education, see Spielman et al. (2008).

not only individual organizations, but also the interactions between those organizations and, in many cases, the incentives that conditioned those interactions.[15]

The alternative framework, as reflected in the quote above from the STI strategy, was to focus on innovative institutional arrangements for organizational interaction. This is often referred to as innovation capacity and incorporates either processes that facilitate such interaction, such as innovation platforms, or more self-organizing networks or agents, such as innovation brokers. This framework moves the research agenda to what works best and how to improve innovation capacity. Recent research has developed some analytical methods to evaluate the efficacy of different approaches to improved innovation capacity (Tigabu, Berkhout, and van Beukering 2013). Such research, however, relies on evaluation of existing projects or approaches, ideally in different contexts and with relatively standardized monitoring systems.

Although innovation system approaches are increasingly being used in the CGIAR,[16] the range of such pilot experimentation is still limited. Much of this work is being done through innovation platforms without a larger analytical framework or testing of options. Such work will probably increase in the future with the growing emphasis on achieving impact at scale. With a significant amount of research in the middle part of the last decade on justifying the approach, providing the conceptual underpinnings, and characterizing approaches, further research on AIS has not gained traction in terms of defining the next stage of research, especially in terms of expanding the range of research methods, nor has there been major impact on policy governing agricultural R&D.

IFPRI has contributed to changing the language and thinking about technological change in developing-country agriculture by shifting discussion and analysis from the simplified linear pathway of research-extension-adoption to a more nonlinear, complex systems approach implied by the innovation systems framework. The thinking and language of innovation systems are now fairly mainstream in the CGIAR centers and programs, and even in the World Bank. This shift in thinking and language is an important and necessary step in changing how agricultural research is organized and executed, and thus is a principal outcome of IFPRI's investment in the AIS research line. Nevertheless, it is only the initial step in achieving larger-scale change in investment and organization of agricultural research and delivery of improved technologies.

To a significant extent, an AIS framework provides the foundation for the 2011 STI strategy. That strategy sets out four research objectives:

(1) "identify technological opportunities, incentives, and institutions that may have important implications for small-scale, resource-poor farmers (both male and female) and other vulnerable social groups in developing-country agriculture;

(2) analyze the progression and constraints thereto associated with moving such opportunities from discovery to delivery;

(3) measure the impacts of these technological opportunities on productivity, poverty, equity, and sustainability; and

(4) recommend policy and investment solutions that increase the probabilities of success in generating these impacts" (IFPRI 2011, ii).

[15] For a focus on incentives and interactions, see Hartwich and Tola (2007).

[16] See, for example, the International Livestock Research Institute's (ILRI) work on fodder (Ayele et al. 2012).

To a significant extent, the implicit impact pathway in these objectives would follow a traditional R&D pipeline. However, the discovery-development-diffusion framework used in the strategy is embedded in an AIS and contains the organizations and institutional arrangements that govern an effective STI system. How to understand and analyze these processes within a complex AIS is still a challenge and characterizes system's research more broadly. As implied by the two approaches to AIS research, there is need to understand both the effectiveness of the individual components of the system, and how they interact and contribute to system performance.

An impact orientation within AIS would focus primarily on institutional and organizational change that leads to greater effectiveness in delivering STI products. Although much of the experimentation with AIS approaches is occurring in international and regional STI agencies, AIS is rarely defined at this scale; rather, it is defined primarily at the national scale. For national systems with well-developed agricultural markets and private-sector capacities, AIS approaches focus primarily on developing public–private partnerships that are usually framed around more basic research supporting improved agro-processing, primarily with competitive grant mechanisms. Given a strategic objective of reducing poverty, IFPRI's policy research on AIS would focus primarily on national systems in SSA, as has principally been the case in the past.

The next phase of policy work on AIS would support directed change in the system, where impact pathways are particularly difficult to specify. Such change would be more evolutionary, rather than a focus on restructuring, and designing incentive systems would be important to achieve this. Innovative budgeting and financing would be critical in providing such incentives across the system organizations, as well as funding the costs of institutional linkages and transaction costs. Coordination and linkage mechanisms would be necessary to minimize such transaction costs, although would be complicated by increasing movement toward decentralization of service delivery. In summary, the "how" question as articulated in the strategy would become the focus of the research, with associated requirements for improved analytical methodologies.

# 4. CASE STUDIES OF POLICY CHANGE

The case studies were designed to assess actual impact. As such, one criterion in the selection of the case studies was a perception of a body of work that had achieved impact. In addition, the cases were drawn to reflect two of the three principal research themes—in this case, genetic resources and priority setting. There was a sense that the research on agricultural innovation systems, which was the most recent, had not reached the point where there was an apparent significant outcome from the research outputs. The case studies are thus examples of outcomes derived from principal research objectives.

## Case Study 1: Conserving and Managing Crop Genetic Diversity

For virtually a decade and a half, GRP1 undertook a significant body of work on genetic resources. From 1994, IFPRI participated in the SGRP, which was led by the IPGRI—now Bioversity International—and which coincided with the entering into force of the Convention on Biodiversity. This began a period of major institutional changes in the ownership, conservation, and distribution of crop genetic resources. Such changes had significant potential impact on the "global commons" that was crop genetic resources, and thus on the work on the IPGs of the CGIAR centers. In particular, the center gene banks were put in trust under an arrangement with the Food and Agriculture Organization of the United Nations (FAO).[17] As such, the gene banks moved from purely serving CGIAR center breeding programs to taking on responsibility for maintaining the world's crop genetic diversity under an expanding set of international agreements. IFPRI's research agenda on genetic resources evolved from an original focus on ex situ conservation to understanding the determinants for in situ conservation. This case study examines the outcomes from IFPRI research, first in the area of ex situ genetic resource conservation, and then in the case of in situ conservation.

### *The Impact of Research on Ex Situ Conservation*

IFPRI's research on genetic resources for the first decade starting in 1994 derived from participation in the SGRP. Initially, the policy work focused on ex situ conservation, as set out in a policy research agenda paper in 1996: "To optimize the future provision of gene bank services, research is needed on the costs of gene banks, the market for their services, the use of genetic resources by breeders, and the implications of recognition of farmers' rights, evolving intellectual property rights, continued funding problems and developments in biotechnology" (Wright 1996, i). A particular part of this research agenda was put into a recommendation of the 1998 EPMR of the SGRP: "The Panel recommends that the SGRP and each crop commodity Centre should give high priority to: objectively quantifying costs of maintenance of accessions of different crops; guaranteeing the long-term security of Centre gene banks; adhering to appropriate standards; and identifying sources of sustainable funding" (Wright 1996, 22). The research agenda set in 1996 was reduced to costing the maintenance of gene banks across the CGIAR as a basis for developing options for long-term financing of these facilities and their operation, which crystalized into the creation of the Global Crop Diversity Trust (GCDT).

The SGRP was fully integrated into the Global Plan of Action (GPA) for the Conservation and Sustainable Utilization of Plant Genetic Resources for Agriculture, which was initiated in 1996 and led

[17] For an evaluation of the impact of the in-trust agreements, see Gotor, Caracciolo, and Watts (2010).

to the negotiation and entering into force of the International Treaty on Plant Genetic Resources (ITPGR) in 2004 and the subsequent creation of the GCDT in 2006. The framing of the concept of the GCDT derived from the idea of a fund that would support the maintenance of the CGIAR gene banks into perpetuity. As part of the SGRP, IFPRI developed the methodology and did the costing of the gene banks in a draft report in 2000. As summarized in the SGRP's annual report for that year, "The [IFPRI] study concluded that the annual cost of conserving and distributing genetic resources from the in-trust collections is about US$5.7 million. The 1994 promise to continue these core gene bank services for all time could be realized through an endowment fund of approximately US$150 million" (Systemwide Genetic Resources Programme 2001). The study's intent was to contribute directly to and justify the development of the fund, which eventually became the GCDT.[18] The Trust supports the maintenance and dissemination of crop genetic resources as a perpetual IPG and its associated benefit stream.

The question being addressed then is whether IFPRI's work on costing of CGIAR gene banks in some manner caused the creation of the GCDT. This attribution problem is in turn related to specification of the counterfactual, which is that the GCDT would not exist without the IFPRI study. As White (2010) notes, in such cases the research is not the sole cause of the creation of such institutions as the GCDT, but contributed in a manner to which the outcome can be attributed. In essence, the research was necessary but not sufficient to cause the outcome. Thus, the question is whether the costing study was necessary to, although not sufficient for, the formation of the GCDT.

However, what is interesting are the different interpretations of what is considered to be necessary in what is a negotiated process in what is in effect institutional innovation. The experts separate into two groups.[19] Those directly involved in the negotiations saw the study as a useful "background" paper but not absolutely necessary to the outcome.[20] In the other group, those who were one step removed from the direct negotiations—especially those at IPGRI—saw the costing work as both providing the methodology for determining the cost and an initial bound on the size and therefore feasibility of the endowment. One perspective was from what informed the negotiation process itself, and the other was from the preconditions necessary to justify the endowment. In the author's view, the methodology development and the actual costing of the gene banks first framed and then focused the idea of an endowment, which required first the passage of the ITPGR and then organizing consensus around the creation of the GCDT. The line of causality is not direct, but there is sufficient support to suggest its presence.

The case does suggest the difficulty of attributing a particular piece of research, which was one among several pieces, to an evolving institutional change process and where the influence of the

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[18] IFPRI's costing of the CGIAR gene banks was first drafted in 2000, well before the actual research outputs were produced. These outputs appeared first as an SGRP paper in 2002, and then as an expanded set of studies in Koo, Pardey, and Wright (2004).

[19] Two critical problems with the attribution problem should be recognized in this case: the length of time that passed since the decisionmaking process and the small sample size of those directly engaged in the decisionmaking process. The latter was made more difficult by a self-selection problem of those who agreed to participate in the survey.

[20] The study found most useful was conducted by the Imperial College London at Wye's Department of Agricultural Sciences in 2002. Titled "Crop Diversity at Risk: The Case for Sustaining Crop Collections," the study was launched at the United Nations World Summit on Sustainable Development in Johannesburg in 2002 and had a strong communication component.

work in essence degraded over time. At the same time, this research was a highly targeted, there was an institutional platform through which to engage with the policymaking process, and the timing was coordinated with the policy process. IFPRI participated in an organizational platform—the SGRP—that was involved in relevant policy fora. This gave the work the legitimacy required to feed into the policy process, as IFPRI already had a high degree of credibility and the topic was highly salient.[21] Nevertheless, while in this case there is support for attributing impact, the case is also suggestive that while all the necessary pieces were in place, there is still no guarantee that the outcomes will be realized.

Measuring the actual benefits of this research would involve establishing the benefit stream from the creation of the GCDT and then attributing a percentage of the benefits to the influence of the particular policy research. As the discussion above suggests, there is no basis for estimating such a percentage. On the other hand, estimating the value of the benefit stream has been a focus of research itself. This work suggests that the theoretical research on the valuation of crop genetic diversity has not been matched by the data needed to undertake such valuation. The few studies valuing genetic resources—for example, rice in India (Gollin and Evenson 1998) and soybean in the United States (Zohrabian et al. 2003)—suggest that the returns on increasing the number of accessions are large. This has led Koo, Pardey, and Wright (2004) to argue that the costs of conserving an accession are lower than any sensible lower-bound estimate of benefits, and thus the task of estimating the benefits is not necessary to justify its conservation. Rather, the focus should be on improving the cost efficiency in the conservation of those genetic resources.

***The Impact of Research on In Situ Conservation***

The 2004 strategy paper (see discussion in earlier chapter) for GRP1 (Smale and Koo 2004) framed the agenda on in situ conservation in terms of farmer-managed genetic diversity. The focus on in situ conservation represented a significant shift from the 1996 research agenda, which framed in situ conservation in terms of a "plethora of critical research questions" that raised issues about the feasibility of in situ conservation and thus argued that it should not be a research priority (Wright 1996, 41). A 2001 program review paper proposed to shift the research focus to "a better understanding of the likely consequences of the changing property rights assigned to agricultural biotechnologies and genetic resources, and related changes in the market structure of science (and changes in the technologies of science itself) on the agricultural innovation process."[22]

Although some work was initiated on IPRs, it never reached a critical mass, as STI research established that IPRs had an ambiguous impact on technology development and was therefore considered not to be a priority.[23] Rather, the predominate focus in the 2004 strategy paper was "the in situ management of cultivated crop plants by agricultural households and communities, or on farm conservation" (Smale and Koo 2004). This work was carried out through and informed by a joint position with IPGRI and Bioversity International from 2002 to 2005, and although there was not a

[21] See the discussion of legitimacy, credibility, and salience in translating knowledge into action in Cash et al. (2003).

[22] This quote comes from an internal program document on GRP1, outlining current research and immediate plans for future research.

[23] The ambiguous relationship between IPRs and technological change in developing-country agriculture was the conclusion of Binenbaum et al. (2003). This relationship was also discussed in a review by Naseem, Spielman, and Omamo (2010).

joint research program between the two institutions, the IFPRI work built directly on existing projects within IPGRI.

Policies that supported in situ conservation were embedded in the larger issues of farmers' use of agrobiodiversity and understanding of the private and social benefits of farmers' management of genetic diversity. An underlying hypothesis was the significant inherent utility in farmers' use and deployment of genetic diversity, with a question of identifying the factors that would cause farmers to reduce this diversity. While both IPGRI and IFPRI had a policy focus on instruments to maintain priority areas of crop genetic diversity, at the same time there was a larger policy issue of how to demonstrate the value of agrobiodiversity in terms of the stability of productivity, as part of a larger sustainability agenda, and then identify the mechanisms necessary to maintain such diversity. This issue generated debate about whether the policy agenda should focus on maintaining agrobiodiversity per se, or rather on the more specific objective of in situ conservation of crop genetic resources, particularly as a strategic complement to the investment in ex situ conservation. Quite different impact pathways were implied, depending on the objective. This distinction only became clearer as the research proceeded over the period of approximately 2002 to 2008.

Moreover, the in situ research objective was very different from the ex situ objective. For the in situ research, there was no clear institutional framework within which to implement policy options and little guidance in terms of an unambiguous impact pathway. In particular, there was no clear mechanism that would provide an incentive for farmers to maintain their crop diversity beyond the risk, producitivity, and stability benefits inherent in managing genetic diversity. Nevertheless, incentive structures could be shifting with closer market integration of the marginal or isolated areas where significant crop diversity might be found, or with the introduction of a limited set of improved varieties. Clarity on this issue would provide the institutional framework for developing in situ genetic resource conservation programs.

This issue of an appropriate institutional framework is still not resolved, and there is debate within Bioversity International about whether such institutional arrangements are in fact needed. Three general approaches are debated with regard to mechanisms for farmer maintenance of crop genetic diversity: (1) enhancing the private benefits that farmers already derive from genetic diversity, such as work on participatory breeding using local populations; (2) mitigating the factors that lead farmers to specialize, such as ensuring maintenance of genetic diversity in markets and seed systems; and (3) developing mechanisms for farmers to capture more of the social benefits from in situ conservation. The first two approaches are context dependent, which has led to testing them through pilot projects.[24] The third approach has more potential for scaling, but requires well-developed institutional arrangements similar to those for carbon trading. The uncertainty in approach for maintaining farmers' incentives made it difficult to develop a focused impact-oriented research agenda, as there were arguments for each strategy and each implied quite different impact pathways. Sorting through these alternative pathways should be seen as a continuing research need that generates international public goods.

Bioversity International has thus maintained work in all three approaches. As an example of one of these, the strategy based on in situ biodiversity as an ecosystem service moved toward developing an impact pathway focusing on payment for agrobiodiversity conservation services

[24] Bioversity International has recently begun to test the efficacy of these pilot approaches for maintaining crop varietal diversity (see Bellon, Gotor, and Caracciolo 2015).

(PACS)—that is, the third approach based on farmers' capturing social benefits from in situ conservation. Such an impact pathway might include the following:

1. Public–private benefit sharing based on valuation tools applied to conserving agrobiodiversity (methods development);
2. Mapping of centers of diversity and prioritization of where to conserve, what to conserve, and how much to conserve;
3. Specific costs and public–private benefits of in situ conservation;
4. Design of monitoring and financing of PACS; and
5. (Molecular) characterization of genetic diversity and maximization of access by seed systems and breeders.

This research agenda requires a multidisciplinary approach. IFPRI brought economic expertise to an ongoing research program at IPGRI, known as Strengthening the Scientific Basis of In Situ Conservation of Agricultural Biodiversity on Farm. This program ran from 1995 to 2005, and from 2002 to 2005, IFPRI and IPGRI shared a joint economics position. Operated in nine countries, the program focused on developing the scientific tools to measure and value genetic diversity on farms and developed the national capacity in each country to undertake such assessment. Most of the countries that generated field data for IFPRI publications were included in this project, particularly Burkina Faso, Ethiopia, Hungary, Mexico, and Nepal. For such multidisciplinary themes, IFPRI has developed research partnerships that, to some extent, prefigured the CRP. In turn, it is difficult to attribute any impacts of such research solely to IFPRI. Scientists from Biodiversity International attribute the economics research that was part of the program to IFPRI's work; however, this research took place at the stage of framing the problem, and therefore focused primarily on the production of IPGs.

IPGRI conducted a workshop in 2002 to define the economic research agenda for in situ conservation, to which IFPRI contributed (Smale, Mar, and Jarvis 2002). While the research focused on farmer decisionmaking about genetic diversity, the policy framework to which this research contributed was broadly defined in terms of genetic diversity as a public good, and in particular the design of "institutional structures [that] are needed to compensate for the inability of markets to provide sufficient incentives for farmers" (Smale, Mar, and Jarvis 2002, 6), particularly when societal benefits signficantly outweighed the costs. Such a framing would appear to argue for an approach based on payment for ecosystem services.

A group at Bioversity International is working on this approach. However, another group argues for a broad range of options to fit particular contexts, and may include the following: "by improving public awareness about sociocultural values of traditional varieties, by providing information on the substitution value of traditional variety diversity for fertilizer and pesticides, moral suasion, regulation and planning, by preventing specific land management practices such as low input zones, by designing agroecological parks or agrotourism zones" (Jarvis et al. 2011, 157). For the last option, the policy agenda has shifted much more to how to incentivize the deployment of agrodiversity, with others experimenting with a range of options. Rather than focusing on the impact pathway, IFPRI research has broadened the policy options, although without directly testing those options. IFPRI has thus contributed to exploring rather than defining the impact pathway.

IFPRI's STI research during this period made a significant contribution to framing the first three steps in the impact pathway listed above, with a particular focus on valuation. A meta-analysis of valuation of genetic resources could only identify nine studies for crop genetic resources, and a third of these derived from IFPRI's STI research (Ahtiainena and Poutaa 2011). The meta-analysis found that "most studies estimated the use values of genetic resources from the perspective of farmers …, the relative magnitude of use and non-use values in plant genetic resources is still unknown" (Ahtiainena and Poutaa 2011, 34). In terms of PACS, pricing of in situ agrobiodiversity services has thus reverted to costing frameworks, in terms of both the additional costs to farmers and the implementation and transactions costs associated with program support (Bioversity International, n.d.). STI research thus made a contribution to both the methods and their application in specific contexts, but not to the resolution of a PACS pricing scheme or of the larger issue of the institutional approach to in situ conservation. The work, however, did justify an enhanced policy research staff in Bioversity International itself.

In situ conservation of agrobiodiversity is still a work in progress. IFPRI's research on the topic provided the methods and initial studies on farmers' decisionmaking and valuation of crop genetic diversity—in summary, the first two steps in a potential impact pathway for such policy research.[25] This work was in marked contrast to the STI program's research on ex situ conservation, in that the publications on in situ conservation generated a succeeding chain of research, mostly by Bioversity, to move further down the impact pathway. The joint position through which much of this work was done ended in 2006, and the STI program shifted much of its focus to biotechnology.

The question does arise in this case of how far down the impact pathway should the research have continued, given the investment that had been made, the succeeding set of research questions, and the steps needed to achieve any type of impact. It might be argued that IFPRI initiates a research agenda, developing the methods and in some cases the databases, and other institutions "closer to the ground" move the research to impact. Given Bioversity International's mandate, there was a high probability this would occur. However, Bioversity is in many ways quite different from the national policy research institutes with which IFPRI normally works, and developing the more specific research agenda and research capacities to ensure progress along an impact pathway will require highly targeted design. The in situ and ex situ cases represent contrasting approaches to "research into use."

### Case Study 2: Improving the Efficiency of Subregional Research in SSA

The 1990s in Africa south of the Sahara (SSA) was a period of low economic growth, structural adjustment and reduction of government budget deficits, significantly reduced donor investment in agriculture, and financial stress on public institutions, including NARIs. Donor assistance in the 1980s had helped to support a period of investment in national agricultural research within a NARI institutional model and with significant support for investment in human capital in the form of PhD training of agricultural scientists. Given the dependence of agricultural research on international development assistance and the number of countries in SSA, a new model was needed for supporting agricultural science on the continent. This also coincided with a shift within the CGIAR toward reliance on project funding, and within that a shift in the locus of funding to SSA. Much of this funding went to support research networks that were primarily organized around commodities

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[25] By 2005, the framework for this work was essentially in place (see Smale and King 2005).

and that linked commodity research capacity across the NARIs in a subregion under management by CGIAR centers.

Although the NARIs remained the foundation of agricultural technology development on the continent, operational funding by either national governments or development assistance was highly constrained. A response to this problem was the creation of the SROs as a means of dealing with the small-country problem in financing agricultural research in SSA. ASARECA became operational in 1994 and was patterned on the Southern Africa Center for Cooperation in Agricultural Research (SACCAR), which is the regional agricultural research platform of the Southern African Development Community (SADC) in southern Africa. As summarized by Oruko (2008), ASARECA's objectives were very much framed around achieving economies of scope and scale in agricultural research across the region: "(1) make spillovers happen across national boundaries; (2) achieve economies of scale and scope in research; (3) produce regional public goods; (4) provide a mechanism to share benefits and costs of collective action; and (5) find research solutions to transboundary problems" (Oruko 2008). The design issue for the SROs was the organizational and program structure needed to achieve these objectives and, in turn, the modality of implementation of these programs.

Although up to 2004 IFPRI had conducted a significant amount of research on the NARIs in SSA through ASTI as well as methodological work on technology spillovers through agroecological mapping, this research had not been coordinated from an institutional perspective. In the same year, ISNAR was incorporated into IFPRI as a research division, which brought this needed perspective. At this time, ASARECA saw the means of achieving the above objectives as bringing some coherence to the multiple and independent range of research networks operating in the region. This goal was to be realized through the development of a Consolidated Conceptual Framework (CCF) through which the networks, programs, and projects (NPPs) would plan their work. At the same time, the CCF would reduce the transaction costs of individual NARIs interacting with a multiplicity of independent research networks. Through some of the CGIAR research networks, IFPRI was involved in incorporating the GIS mapping into strategy development and program planning for particular commodities. As Wood and Anderson (2009) note, "The forumulation of the ASARECA CCF and the subsequent harmonized NPP priority assessment process served both technical and institutional development goals. Increased dialogue and reflection helped build a new, shared sense of identity and commitment that began to enable a set of semi-autonomous and disparate regional networks to realign and to adapt to the need for more regionally and thematically coherent goals, outputs and indicators" (Wood and Anderson 2009, 175–176).

The NPP strategies (of which there would eventually be 17) under the CCF led to a perceived need to bring them together under an improved strategic framework. With USAID funding, IFPRI was asked by ASARECA to develop such a framework. The objectives of the project were "first to identify strategic opportunities for agricultural development policy in the 10 countries covered by ASARECA, with a view to delineating the context in which ASARECA, its national and sub-regional partners in agricultural R&D, and other stakeholders in sub-regional agricultural development might position their own priorities, objectives, strategies and action plans; second, to identify priorities within ASARECA's R4D portfolio" (ASARECA/IFPRI, n.d., 2). The resulting analysis was then to support the development of ASARECA's strategic plan, but in the process also provide a framework for setting priorties for regional research programs. The expectation was that resource allocation in the NARIs would shift based on access to these regional programs and the associated spillovers of improved technologies.

The study employed an innovative methodology combining spatial analysis, a multi-market model simulating regional commodity growth and trade, and commodity priortitization based on spillovers using IFPRI's DREAM model. The report (ASARECA/IFPRI, n.d.) derived from the modeling effort focused on setting priorities in three dimensions: commodities, geographic development domains, and the production-to-consumption continuum. Priority setting in a heterogeneous, subregional context involves more than the search for improved efficiency. Such a priority framework should also provide input to three critical roles of a regional research coordinating body: (1) developing a regional division of labor in seeking a subregional-level scale and scope for economies in agricultural research, (2) developing efficient mechanisms for achieving and potentially optimizing spillovers, and (3) assisting the NARIs with adjusting their own priority setting based on subregional spill-ins.

The regional strategic planning problem is characterized by the CGIAR Sub-Saharan Africa Task Forces: "The vision of the SROs is to gradually influence the NARS [national agricultural research systems] to a stage whereby, for example, the National Agricultural Research Organization of Uganda (NARO) reduces its program in highland maize research to a small adaptive team because it is confident that it can get whatever it needs in this area from the neighboring Kenya Agricultural Research Institute (KARI). Likewise, KARI would reduce its banana research program because it is confident of getting all its needs in this area from NARO. In this way, the national systems will then be able to concentrate on few commodities in which, sub-regionally, they have comparative advantage and become Centers of Excellence for the region and can link up with other regional and international players. If NARS continue with the current system whereby each NARI tries to do everything nationally, then they run the risk of creating organizations which are largely ineffective and inefficient" (CGIAR Secretariat 2005, 28).

An implicit impact pathway for developing an efficient subregional coordination mechanism for agricultural research would be based on simultaneously assembling the above three critical roles. Two of these were explicitly set out in the objectives of the joint study, and the third was implicit in the network structures that were in place in the form of the 17 NPPs. To give further context to the impacts that were achieved from the IFPRI study, the period was one of searching for institutional models. The basic architecture of agricultural research in SSA was essentially in place in the form of the NARIs, the three SROs and the Forum for Agricultural Research in Africa (FARA), and the 15 CGIAR centers, most of which had programs on the continent. While the architectural components were in place, the question was how to best articulate and link them in an efficient, interacting system—a question that remains to this day.

At the level of the NARIs, major donors were questioning their organization and financing under a reform agenda that included the SRO and CGIAR levels.[26] The articulation of the NARIs and the SROs is best described by Chema, Gilbert, and Roseboom (2003): "National reform agendas largely ignore the implications of supranational collaboration in agricultural research. Regional or subregional specialization in agricultural research on specific commodities or topics is not usually included in national agendas. It is a strange omission, but it reflects the fact that most NARS are rather inward looking. Contracting research across national borders is thus very much an exception, and contributing national resources to address supranational research problems is not generally a policy option" (47). Yet, framing national resource allocation within a regional context was one of the objectives of the IFPRI study.

[26] This was most clearly assessed in Chema, Gilbert, and Roseboom (2003).

At the same time, there was significant pressure on the CGIAR to better integrate its programs in SSA with those of the NARIs and SROs. A Sub-Saharan Africa Task Force was created and produced a report in 2005, which argued that "there is a huge portfolio of un-coordinated CGIAR efforts, over-burdening of NARS, overlap of some center activities, lack of integration mechanisms for centers, undefined System vision for CGIAR in Africa, a large number of projects that would have difficulty in qualifying as GPG [global public good]-producing research, and inter-Center dispute on mandates" (CGIAR Secretariat 2005, 26). This report largely ignored the CGIAR's research networks and the processes by which ASARECA was attempting to bring coherence to the CGIAR's work in eastern and southern Africa.

How, then, should the impact of IFPRI's work on priority setting for ASARECA be gauged?[27] This decision depends on the overall objectives that the report was attempting to meet. The limited objective was that ASARECA would adopt the commodity and development domain priorities as a central part of its new strategy. There is universal agreement that ASARECA did adopt the commodity priorities and, to a lesser extent, the development domains. However, the larger lessons were in how this was achieved.

In the initial presentation of the priority framework arising from the study reported to ASARECA's Committee of Directors, there was widespread scepticism about the study's utility as a regional framework. The study brought into focus the very different interests of the three principal players: the NARI directors, ASARECA itself, and the two principal donors. For the NARIs particularly, the study put at risk donor funding directly to the NARIs, and at the same time generated debates about the "regionality" of ASARECA's programs. Decisionmaking in the policy arena often involves trade-offs among the interests of different groups affected by the policy, and this "political economy" needs to be understood in the effective creation or change in policy. As one of the actors closely involved in the development of ASARECA's programs noted, "the case also illustrates that an evidence base, however well documented and explained, is not sufficient to ensure the implementation of optimal policies or mechanisms for allocating resources." As another noted, "thinking through how the benefits of the new focus and spillovers would be achieved and making it part of the strategy would have helped to ease the tensions" between the different parties.

The report was in fact incorporated into ASARECA's 2007–2016 strategic plan, as major portions of the study were written into the two sections on Situation Analysis and Strategic Priorities for Agricultural R4D in ECA [Results for Development in Eastern and Central Africa] (ASARECA, n.d.). As several of the experts have noted, the evidence base developed within the study provided a planning framework for ASARECA, as it developed a regional framework for managing the 17 networks. Previously, these networks were organized based on the specific characteristics and distribution of individual commodities. Bringing them under a coherent regional framework employed particularly the development domains defined within the study. As one expert noted, the framework supported several rounds of planning at ASARECA. In particular, the study "generated valuable discussion on how the NARS in the region could cooperate more efficiently to generate widely applicable research results, but it was never meant to be used as a sole basis for priority-

[27] The report was published by IFPRI as Omamo et al. (2006). One respondent has noted that the report would have had quicker acceptance by ASARECA if it had ASARECA staff as co-authors and, therefore, ASARECA's buy-in to the report.

setting; the more important contribution was the mapping of development domains that made a strong case for regional cooperation and the promotion of spillovers."[28]

However, the larger policy question was the contribution of the IFPRI study—and potentially ongoing research—to ASARECA's development as a regional coordinating body that could operationalize the three critical roles of an SRO discussed above. It should be emphasized that while this was not an explicit objective of the work, nevertheless, the actual operationalization of regional approaches was a major policy issue at the time. The study's last section on Responding to the Priorities has two subsections that begin to frame these issues: (1) Enhancing Services to NARS and Development Partners and (2) Rationalizing and Integrating Networks, Programs, and Projects. These key strategic issues were left to the implementation process, rather than being defined in the strategy itself. The problem is addressed in the IFPRI report: "But then the question is how? How can ECA countries respond meaningfully to these priorities, either individually or in tandem? … Real answers to how to promote growth-enhancing, poverty reducing agricultural development in ECA will emerge only as countries come to grips with the strategic priorities they face in agricultural development, align resource allocations with those priorities, and, perhaps most crucially, fashion new institutional arrangements and processes that translate the outputs of hard-working ECA citizens into tangible and sizable private benefits" (Omamo et al. 2006, 69–70).

An explicit objective of the study was to provide a framework for rationalization of the NARIs' research priorities and thereby to develop a more efficient allocation of limited budgets in the subregion. To a real extent, this would not happen without first demonstrating that such regional capacity existed and was functional before the NARIs adjusted their programs and budgeting—what would become the basis of the World Bank's East Africa Agricultural Productivity Program (EAAPP). To a significant extent, this did exist in the NPPs, which were based on a regional division of labor within each of the commodity networks, rather than on establishing regional centers of excellence—what would become the basis of the EAAPP.[29] However, there would be no analysis of the relative efficiency gains of these different models as a basis for organizing regional research. Rather, ASARECA, having developed its strategy in 2006, completely shifted its approach to organizing regional research.

Two principal trends converged at this point in time: a desire by major donors to stop funding CGIAR research networks; and a very noticable appetite by donors to use competitive grant funds as a primary vehicle to support agricultural research. As Oruko (2008) notes in his history of ASARECA, "In keeping with changing trend world over (sic), the appraisal mission for EU-funded Regional Support Unit recommended the establishment of a competitive grants scheme as a mechanism for funding agricultural research. Designed with the principal objective of building partnerships and research alliances between the NARS of member countries, the CGS [competitive grants system] became operational in 2004 and to date, has served as the main funding vehicle for R4D activities" (Oruko 2008, 5).

In 2006, ASARECA produced its strategy based on a coordination framework for the NPPs. By 2007 with a new support grant from USAID and an operational plan supported by the UK Department for International Development (DFID), funding to ASARECA was primarily based on the

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[28] The direct quotations from experts are not attributed but the experts interviewed are discussed in the Appendix.

[29] For a discussion of this intra-commodity division of labor in relation to plant breeding compared with regional centers of excellence, see Lynam (2011).

development of competitive grant mechanisms. The NPPs were replaced by seven programs that primarily operated and managed competitive grant programs. This had the effect of significantly increasing staff, as managing competitive grants is labor intensive. Moreover, it resulted in resources being primarily allocated to countries with the strongest capacity, as noted by USAID's review mission, "several challenges remain, including the basis for distributing resources across member countries especially in research programs where small country NARIs may miss opportunities to participate because of a comparative lack of research capacity in that particular research area. In striving to maintain a good standard of regional research, this has led to some imbalance in resource allocation with current concentration of projects in Kenya, Uganda, and Tanzania (76 percent of the total project funds allocated)" (DAI 2011, 14).

Even within the competitive grants framework, there was recognition of the value of the development domains for targeting. "The current Strategic Plan priorities benefited from identifying agricultural development domains (with the support of the International Food Policy Research Institute) that generally cross national borders. We recommend that ASARECA programs systematically employ this concept in facilitating the targeted scaling-up of technologies and innovations. Stronger use of the domain map would also strengthen proposal development by making it easier for lead scientists to identify potential project partners beyond their current experience, and encourage closer project collaboration across countries in carrying out joint research. We recommend that all projects with earliest effect include measures to promote spillovers along development domains within and across countries in their design and implementation" (DAI 2011, x–xi).

In the view of the experts consulted, the IFPRI study contributed significantly to improved planning and decisionmaking in ASARECA. However, did it achieve the impacts usually associated with a priority-setting framework: improved resource allocation within the context of a subregional research program? As one of the authors notes, "the organizational/institutional reform agenda that lay behind the work was never really made explicit as we crafted the terms of reference (ToR) and undertook the work itself. Our task at the time was to provide an empirical/analytical foundation for relatively high-level priority-setting discussions. We never discussed the 'how' question."[30] This assessment is fair, but it does raise the question of what additional research would have helped ASARECA move closer to both its overall objectives and thus improved efficiency in the resource allocation process.

Several key succeeding steps might have better facilitated the incorporation of a priority-setting framework in resource allocation: (1) a clearer matching of priorities to decisionmaking within the subregional research coordination programs, (2) enhanced capacity within ASARECA itself to both understand the models and continue to integrate their use within the programs, and (3) the development of a more robust tool for evaluating spillovers and matching that to capacity to implement those spillovers.[31] The potential to impact NARI resource allocation within a subregional

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[30] The direct quotations from experts are not attributed but the experts interviewed are discussed in the Appendix.

[31] In this reviewer's view, although debated by some of the experts, IFPRI missed an opportunity (always best viewed in hindsight) to assess organizational models for subregional research, which could have contributed to better assessment of institutional design options by both donors and the SROs. This is still a gap in the literature and could have precluded ASARECA's current funding difficulties regarding substantially reduced

framework still remained a challenge; moreover, to a large extent it was made superfluous with the advent of the competitive grants mechanism. As one of the experts noted, the study "could have been followed up with more detailed mapping and analysis of the organizational and management changes that would be needed to facilitate the scaling up of technologies in multiple countries."[32]

Finally, an additional—and not to be undervalued—spillover from the ASARECA priority setting was the credibility that ASARECA gained in the broader development community from the study, in effect giving ASARECA enhanced visibility among the three SROs. This resulted in requests by the other two SROs to undertake similar research in their respective regions. At the same time, this allowed a sharpening of the methodology, although without extension into organizational models for regional research.[33]

contributions to the Multi-Donor Trust Fund, a significant curtailment of grants, and an overinflated staff (see World Bank 2014).

[32] The direct quotations from experts are not attributed but the experts interviewed are discussed in the Appendix.

[33] See a comparison of the three subregional models in Johnson et al. (2011).

# 5. BIBLIOMETRIC ANALYSIS: IFPRI'S INFLUENCE ON THE LARGER POLICY RESEARCH COMMUNITY

As a CGIAR research center, IFPRI faces the dual responsibility of producing IPGs and at the same time ensuring research relevance through demonstration of impact. For the crop and NRM centers, this involves working across a signficant part of the R&D spectrum, from higher-end strategic research on such areas as production of C4 rice, to the development of seed systems for self-pollinating crops. IFPRI must work across this same spectrum, balancing research that frames a development issue, as with the earlier work on the contribution of agricultural research to growth in the agriculture sector, with more targeted (and location-specific) research that contributes to policy change and impact. There is the potential for signficant trade-offs in working across this spectrum, especially for an organization whose reputation largely proceeds from its ability to lead and to frame larger policy debates in the areas of food, agriculture, natural resources, and nutrition.

The currency of IFPRI's research is published papers. The influence of IFPRI's research on the larger policy research community is usually analyzed in terms of citations of those papers by others working and publishing through primarily policy research journals. The research output in the work on STI over the period 1995–2012 is indeed impressive, as shown in Table 1. The column on discussion papers includes work published through IFPRI discussion papers and reports, as well as conference papers. As will be shown below, this is an important avenue for reaching the broader community. As an example, ASTI primarily relies on this vehicle. As discussed above, the research themes are listed in terms of how recently they became opertational, and essentially represent a particular phase of work within STI. An area such as IPRs was included in an early strategy, but never developed a critical mass of work. The idea of a critical mass of research is important, as discussed in previous sections, in that it allows the research to evolve from policy relevance to policy impact, and combines research on framing the policy problem, methodology development, application in specific contexts, and continued testing and exploration of the impact pathway. Thus, it is not surprising that different research themes have phased in and phased out over the period under review, although they often have been based not on an explicit assessment of alternative research priorities, but rather on staffing and institutional partnerships, not to mention project funding.

**Table 1: IFPRI STI research outputs by theme**

| Research Theme | Journal Articles | Discussion Papers | Book Chapters | Books |
|---|---|---|---|---|
| Agricultural Research and Productivity | 33 | 25 | 15 | 7 |
| Agricultural Science and Technology Indicators | 4 | 36 | 6 | 2 |
| Intellectual Property Rights | 4 | 5 | 1 | 1 |
| Genetic Resourses and Diversity | 48 | 40 | 14 | 5 |
| Biotechnology and Biosafety | 40 | 40 | 7 | 0 |
| Agricultural Innovation Systems | 27 | 29 | 2 | 0 |

Source: List of STI publications provided by IFPRI.

For the analysis of citations, those reported by Google Scholar are used. Compared with the International Statistics Institute and Research Papers in Economics (RePEc) Google Scholar gave a fuller evaluation of the number of citations in terms of both the papers reported upon and the number of citations. A cutoff of 25 citations was used as an indicator of signficant incorporation of the results into the research of the agricultural policy community. While this cutoff is an arbitrary, it nevertheless leads to some interesting inferences across the research themes, as reported in Table 2. First, this is an impressive result in that 22–33 percent of the total output of each theme made the cutoff, which speaks to the quality of the work and its use by the larger commuity. Several papers were cited more than 200 times, with the highest being the *Science under Scarcity* (Alston et al. 1995), which was cited 1,191 times (and still counting). These data speak for themselves in terms of the influence that IFPRI research in the STI area has on the larger policy research community.

Nevertheless, it is striking to note the differences across the research themes. Such differences are not fully comparable, since the agricultural research theme was the earliest to operate and thus has a longer time period in which to accumulate citations. Yet, the differences are suggestive, and one interpretation of the extended distribution of the agricultural research theme in comparison with bunching at the lower end for the other themes is the size of the research community to which the research was directed. The research under the agricultural research theme was more in the agenda-setting or problem-framing (that is, IPG) mode, which can in turn generate an extended line of subsequent research. However, its use in actual policymaking would be difficult to demonstrate, even for the priority-setting framework that is at the heart of *Science under Scarcity* (Alston et al. 1995). As discussed previously, such agricultural research organizations as the CGIAR have largely moved away from such methods with the dependence on project-based funding. This is suggestive of the significant trade-offs in producing IPGs of the quality developed under the agricultural research theme and the contextualized impact that underlies the policy research in much of the other three themes. This trade-off was also highlighted in the impact study on IFPRI's water resource allocation program: "The task facing the program (and IFPRI more generally) is confounded by its dual nature. Specifically, a key goal is for research to produce global public goods, and at the same time, to be relevant in policy contexts that are issue specific" (Bennett 2013, 39).

**Table 2: Number of STI publications by varying strata of citations in Google Scholar**

| No. of citations | Agricultural research | | | | Genetic resources | | | Biotechnology | | | Innovation systems | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Journal paper | IFPRI paper | Book chapter | Book | Journal paper | IFPRI paper | Book | Journal paper | IFPRI paper | Book chapter | Journal paper | IFPRI paper |
| 25–49 | 3 | | 2 | | 8 | 1 | 1 | 9 | 3 | 1 | 2 | 4 |
| 50–74 | 1 | 1 | | | 7 | 1 | | 1 | 2 | | 4 | |
| 75–99 | 1 | 1 | | 1 | 4 | | 3 | 1 | | | 2 | |
| 100–149 | 4 | 1 | | 1 | | 1 | | 1 | | | 3 | |
| 150–199 | 2 | 2 | | | | | | | | | 1 | |
| 200–299 | 2 | 1 | | | | | | | | | | |
| 300–499 | | 1 | | | | | | | | | | |
| 500–599 | | 1 | | | | | | | | | | |
| 600–699 | 1 | | | | | | | | | | | |
| >1000 | | | | 1 | | | | | | | | |

The discussion papers and reports issued by IFPRI are cited quite extensively, in some themes as much as journal articles. This indicates the IFPRI website is used widely by the policy research community, and that these reports are cross-listed in other policy research databases, such as RePEc. The only other note on the citations is that the papers that were most cited in the innovation system theme were all related to extension. This is an area where investment has been highly variable, where methods are being experimented with, and where the most appropriate organizational model is much debated. This could be indicative of demand for further framing of the extension problem.

The issue of further research on extension leads to the question of whether the STI program worked on the right topics—that is, where IFPRI could have the most impact. This issue leads to the question of how to set priorities for STI policy research, which faces all the methodological challenges of impact assessment. Policy research priorities are partly a function of demand, of foresight on emerging topics, of the relative research needs across the impact pathway, and in the science area of the availability of appropriate partnerships or institutional platforms. As the assessment above has stressed, STI policy research has faced a continuing issue of opening up new research topics or extending work in existing topics to improve the possibility of impact. Each of the four STI topics has its own set of practitioners and final "consumers," and as the case studies demonstrate, there was value in the research that was conducted, but at the same time there was demand for or identified gaps needing further research to reach impact.

Switching to another major topic in turn implies opportunity costs in terms of such unfinished research agendas, but also in terms of other topics. As the assessment has argued, a new topic requires a medium-term investment of at least five years, which has more or less tracked the history of IFPRI's STI policy research.

# 6. CAPACITY BUILDING AND PARTNERSHIPS

As the CGIAR moves toward results-based management, impact moves from the notion of agents and institutions adopting center research outputs where they happen to be contextually relevant (namely, impact studies based on where there has been demonstrated impact), to designing research programs and projects with the intention of achieving specified outcomes. In this case, research must be designed with an impact orientation—that is, with some idea of an initial impact pathway. This shift in research design is expressed by the CGIAR PIM Research Program: "PIM joins with boundary partners (research, implementation, and outreach partners) to deliver outcomes and contribute to impact. PIM assists primary decision agents in effecting change by providing relevant knowledge and enhancing their capacity. Evidence of impact is gathered by documenting change (or in some cases avoidance of welfare-reducing change), and soliciting feedback regarding the relevance of research to the outcome" (PIM 2014, 2). Such intentionality is relatively new and extends IFPRI's work into the research-into-use domain. As the quote notes, this necessarily involves much more specificity in terms of partnerships and associated capacity-strengthening activities.

Capacity strengthening within the STI program has focused on building policy research capacity, especially in partner institutions. The 2011 STI strategy noted that the program should "have strong potential for collaboration with developing-country counterparts, in a way that encourages capacity strengthening through replication, expansion, adaptation, and improvement of research at a national level" (IFPRI 2011, 26). With the new focus on results, capacity strengthening becomes a critical component of the ability to achieve policy change, as it becomes the mechanism to link research knowledge to more effective decisionmaking. This view is well expressed in the 2011 strategy, which notes that STI "programs face the key problem of a persistent emphasis on the supply side elements (for example, data and analytical tools), rather than on the demand side (for example, decisionmakers). Thus, a key challenge to making these approaches work more effectively is to link them more closely with decisionmaking processes to ensure a more systematic demand for and supply of knowledge support. This translates into the need for a theory of policy change in which research plays a more explicit role, and a better understanding of how policy change in ST&I can generate favorable results for the development and delivery of pro-poor science and technology" (IFPRI 2011, 23). This reflects the fact that evidence-based policy change requires a certain level of contextual specificity and that the ability to make that translation comes best from domestic institutions.

This approach was central to IFPRI's work on in situ conservation, and was designed into the 10-year, IPGRI-led project. As noted in the 2004 strategy document, "in order for the research to be relevant to policymakers in developing countries, it must be undertaken where national scientists from those countries have made a commitment to related research and issues related to biodiversity are on the table" (Smale and Koo 2004, 23). A cadre of economists from the nine countries was trained through a combination of joint research under the project and short courses. A 2006 impact study of the project found that "strong linkages have been forged between biological and social science programmes in institutes and universities … and capacity has been built through formal and informal training that has strengthened … male and female personnel knowledge about plant population biology, ecology, biogeography, conservation biology, economics, sociology and anthropology" (MacKay 2006, 21). In this example, the focus was on building national, multidisciplinary teams, which was an explicit objective of the 10-year program. This intent is also displayed in the increasing number of national partners who are co-authors on IFPRI publications.

The work on innovation systems in Ethiopia and Vietnam is a good example of this (Spielman and Kelemework 2009).

However, the overall assessment of the STI program argues that moving policy research into use requires not just research, partnerships, and capacity but also the close articulation of all three of these components within particular economic and institutional contexts, and often where phasing and appropriate timing are also crucial determinants. As with crop improvement research, if there were well-developed seed systems and extension systems, the CGIAR could concentrate solely on crop-breeding—and potentially just pre-breeding—activities.

IFPRI faces the same constraints in terms of not having highly functional policy research capacity in national programs in SSA and small developing countries, especially in the STI domain. For STI, especially in areas like genetic resources and biotechnology, much of the policy research and the linkages to decisionmakers would be through the NARIs. Socioeconomic units usually exist in the NARIs, but their capacity is usually very limited, especially in terms of using the methodology and survey techniques used in IFPRI's research. In IFPRI's country programs, partnerships have been developed with the economic policy research institutes that the World Bank helped to create in SSA in the 1990s. However, in general, the partnerships and associated capacity strengthening will depend on the theme and the specific policy change that is targeted. As reflected in the co-authors on the published papers, most though not all were PhD students or postdoctoral researchers, rather than economists drawn from the NARIs or other national policy research institutes. The research needed for specific policy change requires tight linkages among the research, the partnerships, capacity strengthening, and thus the targeted policy change.

# 7. CONCLUSIONS

## The Challenge of Impact Assessment of Policy Research

Attributing change to the production and distribution of policy research papers is a challenge, with approaches varying from the statistical approaches found in the economics literature to causality as defined within the evaluation literature. This impact assessment has adopted the latter approach, has placed research outputs of IFPRI's science policy program within an implicit impact pathway, and has assessed how far down this impact pathway research outputs could have influenced policy change. Research outputs were assessed against the impact pathway in terms of types of research outputs—namely, agenda setting or problem framing, methodology, case studies, and specific policy recommendations—as a research-to-use continuum.

Research outputs across four principal thematic areas were assessed using this framework, followed by case studies to provide evidence on whether policy change in fact did take place as a result of the policy research outputs. This approach was chosen because of both the varied nature of the topics and research outputs being reviewed and the extended period over which the assessment took place. The assessment, in turn, was framed in terms of different policy changes or outcomes: regulatory policy changes, for example, IPRs or biosafety regulations; changes in budgetary allocation; or organizational change.

An initial hypothesis was that STI research would primarily influence budgetary allocations. It is not possible from the evidence available to conclude that this did not happen, but the case studies suggest that the impacts or possible impacts were much more in the area of organizational or institutional change, with the suggestion that there is scope for more work in this area to generate impact with STI policy research.

## The Impact of STI Research

IFPRI's science policy research can be evaluated at different stages, from influence on policy agendas, to changes in policy, to impacts from policy change. Based on the citation review, IFPRI's STI research has had a significant influence on subsequent research in critical thematic areas. The earlier work on investment in agricultural research and the returns to such investment had a broader influence across the policy research community than the latter work on genetic resources, biotechnology, and innovation systems—areas with a narrower research focus, fewer researchers working, but also with a tighter impact pathway. In these latter areas, it was possible to demonstrate how IFPRI research served to populate that impact pathway, moving the research agenda to more actionable policy recommendations. In the case of in situ genetic resource conservation, the research further down the impact pathway was taken up by Bioversity International.

It is not possible in this review to provide evidence for further extension of research down the impact pathway in the case of the biotechnology or innovation system work. Research agendas obviously shifted in the STI area over the period under review. How to balance the extension of research down an impact pathway versus starting research in a new area is obviously an issue in the STI program, which requires assessing the trade-offs between new areas of IPGs versus ensuring moving research into use. As the case of the GCDT demonstrates, moving research into use depends on highly targeted research at a critical time in policy deliberations within an effective institutional platform to influence those decisions.

## Critical Mass and Continued Testing of the Impact Pathway

IFPRI is in a relatively unique position among policy research institutes in working across the research-to-impact continuum. To a significant extent, IFPRI's reputation has been built through research that influences research agendas and has resonance with the larger policy research community. To advance from such research to actual change in policies requires either IFPRI fleshing out more finely targeted and actionable research along the impact pathway, or relying on other more applied policy research institutes, often with closer relationships with policymakers, to undertake such research. The experience with STI research is primarily that of the former, where IFPRI enters a research area or theme for a significant period of time, establishes credibility in the theme, and then develops a critical mass of research—something of a pipeline between framing the problem and actual policy change. Developing a critical mass of research over a requisite period of time allows an ongoing testing of the impact pathway.

In many ways—and this is before the move by IFPRI toward an impact orientation—the development of the research in each of the thematic areas did not make explicit such an impact pathway, there was often too much research in the case study modality when shifting to the next stage of the impact pathway would have provided higher returns, and there was often little in the way of institutional platforms to move the research into policy processes. Such a framing of the research process begins to provide a basis for setting priorities, at least within a well-defined impact pathway. Except for the work on ex situ genetic resource conservation, for the rest of the research themes there remained significant areas of research to be carried out to begin to be applied in actual policy formulation.

## Articulating Research, Partnership, Communication, and Capacity Building

At the lower end of the impact pathway, IFPRI is still developing its approach to putting research into use. This work is primarily being organized within specific country programs, especially where there are IFPRI country offices. A recent review of IFPRI's capacity-strengthening programs found that such activities had most benefit in countries where IFPRI staff was based, and that such benefit came through learning from joint, collaborative research. The study found that "scores for relevance, quality and design, and capacity built or output are good to very good, scores for capacity utilized or outcome are lower but still good, but impact scores are mixed, ranging from unsatisfactory to good" (Kuyvenhoven 2014, xi). This finding is suggestive of the difficulty in simultaneously developing actionable research adapted to local context, effective partnerships or institutional platforms, local capacity, and effective dialogue with policymakers. Forming partnerships with institutes that can undertake this type of research is possible in China and even Bangladesh, but is much more difficult in Malawi, Mozambique, and Uganda.

Such country programs generate policy research agendas that are more bottom up in terms of theme or topic. On the other hand, research of the type produced in the STI program is more top down, but where operational modalities at the bottom end of the impact pathway requires finding country or regional contexts where there is potential for moving research into use, which may not be where there is an existing country office. All CGIAR centers struggle with this dilemma of how to bridge between the goals of producing IPGs and achieving impact under conditions where adaptation to local context is crucial. Nevertheless, in the area of STI policy, IFPRI can use not only its own country offices and networks, but those of the CGIAR as a whole as well. The capacity exists to match IFPRI and CGIAR research agendas to specific country needs; the challenge still remains in articulating the research with local capacities and policy processes.

## Evolving the Research Agenda in Science Policy

Establishing research priorities within an impact pathway requires a framework that is quite different from that for setting priorities across themes or topic areas within the agricultural science domain. There has not been a deliberate attempt to do either over the history of the program. Rather, the program has responded to opportunities, institutional links, and the research interests of the principal scientists. However chosen, the research themes have found a significant constituency, and have generated, if not impact, a significant contribution to establishing the impact pathway in that research theme. Nevertheless, there are opportunity costs, and given IFPRI's position in this important domain, the question arises of where IFPRI might develop its next principal research themes in the science policy arena.

Over its history, the IFPRI STI program has traded off emerging issues on the institutional/ organizational side of science policy with the emerging issues in the science itself. A question posed by this reviewer is whether the two issues might be brought together in the links between agricultural innovation systems on the organizational side and sustainability/resilience on the production systems side. This is hinted at in IFPRI's 2011 strategy, but is not fleshed out (IFPRI 2011). Concerns for sustainability and resilience have given rise to such issues as sustainable intensification, climate-smart agriculture, conservation agriculture, and a range of systems approaches to meet both productivity and ecosystem service objectives. These issues have rarely been framed within a context of how to best organize agricultural research around such agendas, or how to organize delivery systems for such techniques, or what incentive structures would promote the adoption of such "system" technologies. IFPRI's science policy program has demonstrated its ability to develop a progressive agenda in the research themes on which it has focused. In a world where science is looked to for solutions to future challenges to food production, some integration of an evolving science agenda with the institutional requirements for such an agenda would appear to be a basis for IFPRI's own STI research agenda.

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# APPENDIX: INTERVIEWS FOR THE CASE STUDIES

The case studies were carried out through interviews of key informants involved in the decisionmaking process that formed the core outcome of the case studies. In two of the cases—for in situ genetic resource conservation and for priority setting for subregional research—that outcome was not well defined. For the ex situ case, there was clarity on the outcome, but lack of consensus on the role of IFPRI research. For the ex situ and subregional research cases, the outcomes from a particular piece of research was assessed, while for the in situ case a body of research was evaluated. At the same time, there was a discovery process of the central players in the decisionmaking, as well as increased clarity on the impact pathway. The interview process was open ended and carried out either by Skype conversations or by email. A chain of interviews increased the specificity of the questions, arriving at a body of evidence, together with key documents, on the role of the research in particular case study outcomes. The list of key informants interviewed follows:

*Genetic Resources:*

a) Mauricio Bellon
b) Adam Drucker
c) Eshan Dulloo
d) Cary Fowler (deferred to Geoffrey Hawtin)
e) Elisabeth Gotor
f) Geoffrey Hawtin
g) Devra Jarvis
h) Melinda Smale

*Subregional Research Priorities:*

a) Howard Elliott
b) Peter Ewell
c) Were Omamo
d) Michael Waithaka

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42. **Taking Stock: Impacts of 40 Years of Policy Research at IFPRI,** *by Peter Hazell and Roger Slade* (December 2015)

41. **Workshop on Best Practice Methods for Assessing the Impact of Policy-Oriented Research: Summary and Recommendations for the CGIAR,** *by Frank Place and Peter Hazell* (December 2015)

40. **Ex-Post Impact Assessment Review of IFPRI's Research Program on Social Protection, 2000–2012,** *by Suzanne Nelson, Tim Frankenberger, Vicki Brown, Carrie Presnall, and Jeanne Downen* (August 2015)

39. **Ex-Post Evaluation Study of IFPRI's Research on High-Value Agriculture, 1994–2010,** *by Jonathan Kydd* (June 2015)

38. **Impact Assessment of IFPRI's Capacity-Strengthening Work, 1985–2010,** *by Arie Kuyvenhoven* (December 2014)

37. **Impact Assessment: IFPRI 2020 Conference on Building Resilience for Food and Nutrition Security, May 15–17, 2014, Addis Ababa, Ethiopia,** *by Robert Paarlberg* (December 2014)

36. **An Assessment of IFPRI's Work in Ethiopia 1995–2010: Ideology, Influence, and Idiosyncrasy***, by Mitch Renkow and Roger Slade* (June 2013)

35. **An Ex-Post Impact Assessment of the IFPRI's GRP22 Program, Water Resource Allocation: Productivity and Environmental Impacts***, by Jeffrey W. Bennett* (March 2013)

34. **Impact Assessment: IFPRI 2020 Conference on "Leveraging Agriculture for Improving Nutrition and Health," Delhi, India, February 10–12, 2011***, by Robert Paarlberg* (December 2012)

33. **Ex-Post Impact Assessment Review of the Regional Network on AIDS, Livelihoods, and Food Security (RENEWAL)***, by Tim Frankenberger and Suzanne Nelson* (December 2011)

**Series Name Change Announcement**

**The Impact Assessment Discussion Paper (IADP) series has been renamed "Independent Impact Assessment Report" beginning with report #36, and the numbering for this series will continue from the IADP series.**

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31. **Impacts of IFPRI's "Priorities for Pro-Poor Public Investment" Global Research Program**, *by Mitch Renkow* (October 2010)

30. **Case Study on the International Food Policy Research Institute (IFPRI) and Conditional Cash Transfer (CCT) and Non-Conditional Cash Transfer (NCCT) Programs**, *by Jere Behrman and Maria Cecilia Calderon* (December 2009)

29. **The Food Crisis of 2008: Impact Assessment of IFPRI's Communications Strategy**, by Ingeborg Hovland *(December 2009)*

28. **Impact Evaluation of Research by the International Food Policy Research Institute on Agricultural Liberalization, Developing Countries, and the WTO's Doha Negotiations,** *by Joanna Hewitt (September 2008)*

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