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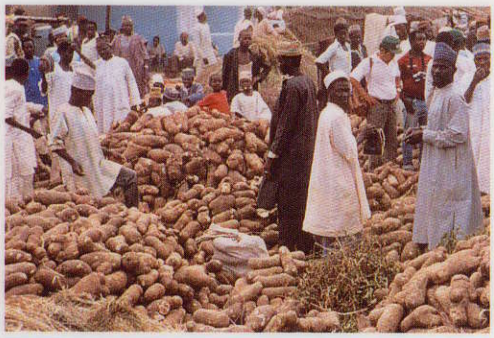
Achievements in Impact Assessment of Agricultural Research: IITA experience, 2001–2006



International Institute of Tropical Agriculture – Institut international d'agriculture tropicale – www.iita.org

Ibadan, Nigeria
Telephone:(2342)2412626
Fax:(2342)2412221
E-mail:iita@cgiar.org
Web:www.iita.org

To Headquarters from outside Nigeria:
c/o Lambourn (UK) Ltd Carolyn House
26 Dingwall Road, Croydon CR9 3EE, UK

Within Nigeria:
PMB 5320, Oyo Road
Ibadan, Oyo State

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V.M. Manyong, A.D. Alene, D. Sanogo, O. Coulibaly, S. Abele, and G.B. Nkamleu

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V.M. Manyong[1], A.D. Alene[2], D. Sanogo[2], O. Coulibaly[3], S. Abele[4], and G.B. Nkamleu[2]

[1]IITA, Tanzania, PO Box 6226 Dar es Salaam

[2]IITA, Nigeria, PMB 5320 Ibadan

[3]IITA, Bénin, BP 08-0932 Cotonou

[4]IITA, Uganda, PO Box 7878 Kampala

Abstract

The purpose of this document is to take stock of the achievements of and gaps in impact assessment (IA) research at IITA since the last External Program and Management Review in 2001 and to highlight elements of a strategy for the future of impact studies at the Institute. Our vision of IA is that it is a continuous process. It covers a wide range of interrelated activities including baseline studies, *ex ante* impact, on-farm technology evaluation, adoption studies, and *ex post* impact. IITA has developed a framework for conceptualizing and promoting impact culture in agricultural research to guide and facilitate the implementation of IA research. During the conduct of impact studies, both quantitative and qualitative techniques have been applied. IITA has made tremendous achievements in assessing the impact of its Research-for-Development products and has contributed significantly to capacity building, communication of findings from IA, and development of international public goods. The review concludes with major IA research initiatives and challenges ahead.

Key words: Agricultural research; Impact assessment; IITA; sub-Saharan Africa.

Introduction

The International Institute of Tropical Agriculture (IITA) is an Africa-based organization. IITA's mission is to enhance food security and improve livelihoods in Africa through Research-for-Development (R4D). In collaboration with national agricultural research systems and other partners, IITA has developed a number of improved varieties, practices, systems, and processes and these products have been disseminated widely in sub-Saharan Africa (SSA). Between 1970 and 1998, for example, 206 improved cassava varieties—with nearly 50% average yield advantages over traditional varieties—were released in 20 countries in SSA and planted on over 22% of the cassava area. These achievements have been made possible through a multi-stakeholder and multidisciplinary research approach that ensures technologies are appropriate, profitable, and socially acceptable, with a view to promoting adoption and achieving greater impact on the livelihoods of the poor in SSA.

Impact assessment (IA) is one of the major disciplinary areas of research supporting the innovation processes at IITA. IA research generates and transfers knowledge leading to a more focused agenda and increased adoption and impact of technologies. Specifically, IA research at IITA aims to: (1) identify key production constraints and desirable agronomic and utilization characteristics to guide appropriate technology development; (2) analyze adoption pathways and estimate potential economic impact to guide strategic priority setting; (3) assess farm-level profitability and acceptability; and (4) assess actual adoption and impact of the products of IITA's research. The various themes are highly interlinked. For example, characterization and constraint prioritization studies provide baseline information for IA. Similarly, adoption studies documenting the extent and determinants of uptake of IITA's technologies—such as socioeconomic and institutional factors—provide important information not only for evaluating the adoption potential of new technologies but also for enhancing adoption through improved policies and institutions. IA research documents lessons about successes and failures and contributes to priority setting. Indeed, attaining the basic CGIAR goals of poverty reduction, food security, and environmental protection requires not only appropriate technologies but also good policies, institutions, and infrastructure. The interaction of these factors determines the potential for technology adoption and the commercialization of smallholder agriculture.

In general, IA research focuses on *ex ante* IA for priority setting, planning and adoption studies, and on *ex post* IA for measuring impacts on livelihoods. Specifically, it involves quantifying the uptake of IITA technologies and developing and applying methods for setting agricultural research priorities and for assessing the impact of IITA's research. The outputs from IA research provide essential insights and feedback to the R4D process. With new initiatives and increased involvement of IITA in R4D, however, the scope of IA research has now become broader. The purpose of this document is to take stock of the achievements of and gaps in IA research at IITA since the last External Program and Management Review (EPMR) in 2001 and to highlight elements of a strategy for the future of impact studies at the Institute. It is also in line with the Center-Commissioned External Review in 2003 on the Social Science Program at IITA, which recommended the need to strengthen the impact culture at IITA.

The second section describes the vision, framework, and methods used in assessing the impact of R4D activities at IITA. The third section presents the achievements on the three broad components of IA (prioritization of production constraints and opportunities in agricultural systems, *ex ante* impact, and adoption and *ex post* impact), capacity building, communication of results, and contributions to international public goods (IPGs). The last section highlights the major initiatives and challenges ahead.

Impact Assessment

Vision

Our vision of IA research at IITA is that it is a process rather than a one-time activity (Manyong et al. 2001 in CGIAR 2001). It is conceptualized and operationalized as a continuous process (Fig. 1). The IA process is also closely associated with the technology development process itself. Based on this process, therefore, the impact cycle constitutes five stages of IA—prioritization of constraints and opportunities, *ex ante* IA, on-farm technology evaluation, adoption studies, and *ex post* IA. The different types of IA research are not mutually exclusive; they rather serve distinct and at the same time complementary functions in the technology development and dissemination process.

The identification of constraints, opportunities, and possible solutions is where IA begins, and leads to a priority setting task using *ex ante* impact analysis that estimates the potential impacts of alternative research portfolios on poverty alleviation or aggregate net benefits. This is based on data generated from a baseline survey, expert knowledge (e.g., from biophysical scientists and research managers), and information from previous adoption and impact studies. Baseline data allow researchers to establish the current levels of poverty; information from biophysical scientists and research managers helps to predict likely changes in yields, costs, and other needed parameters; and information from previous adoption and impact studies is used to identify alternative technologies that would address the major production constraints while at the same time taking into consideration farmers' preferences and farming conditions.

Priority setting is followed by (on-station) technology development and on-farm evaluation that are carried out to identify an appropriate technology under farmers' conditions and based on their priorities and preferences. Approprate technologies are then promoted or scaled-up and -out, starting from the initial trial-hosting villages to other villages, districts, provinces, and regions. As technology dissemination is underway, adoption studies become very important to document the process and levels of adoption and changes in productivity and cropping patterns. These are conducted as case studies on adoption and impact. Finally, *ex post* studies on adoption and impact are carried out following large-scale dissemination of the technology. The IA process becomes complete when adoption and impact information obtained from *ex post* impact studies is fed back to *ex ante* impact studies and the process continues, as technology development itself is continuous.

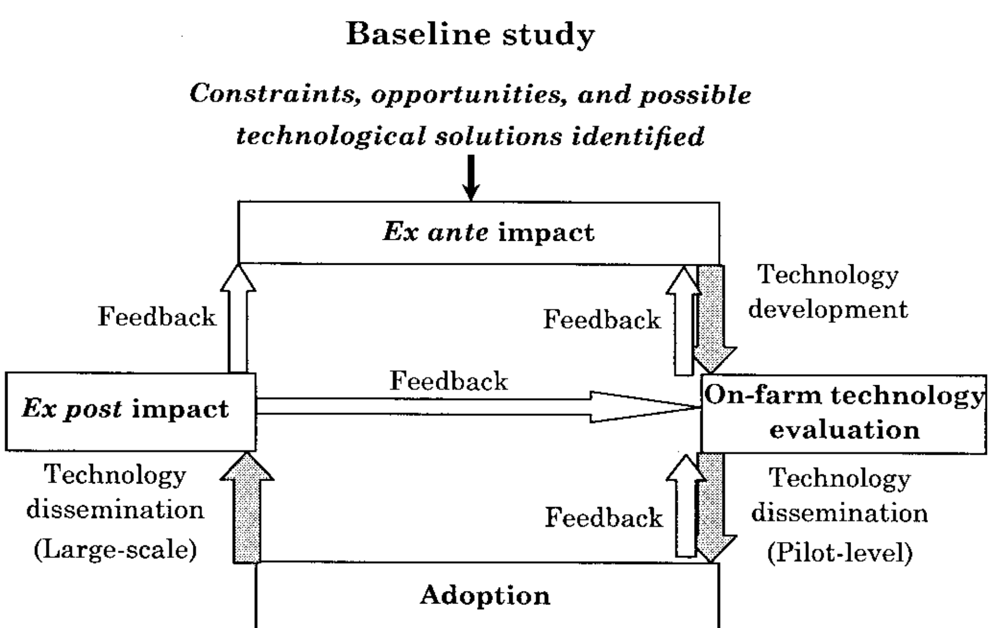

Figure 1. The impact assessment process.

Source: Alene et al. (2006a).

Framework

At IITA, IA research draws heavily on the Sustainable Rural Livelihoods Framework (SRLF). It uses a range of quantitative and qualitative information and applies quantitative and qualitative analyses to assess the impact of agricultural technologies on incomes, food and nutrition security, and livelihoods. The *assets* upon which people build their livelihoods are of particular interest. A wider range of *assets* is included than those usually considered. Rather than looking only at land and its productivity or other classic wealth indicators, the SRLF suggests consideration of a portfolio of five different types of assets (DfID 2001).

- *Natural capital:* land, water, forests, marine resources, air quality, erosion protection, and biodiversity,
- *Physical capital:* transportation, roads, buildings, shelter, water supply and sanitation, energy, technology, communications, or other household assets,
- *Financial capital:* savings (cash as well as liquid assets), credit (formal and informal), as well as inflows (state transfers and remittances),
- *Human capital:* education, skills, knowledge, health, nutrition, and labor power, and
- *Social capital:* networks that increase trust, ability to work together, access to opportunities, reciprocity, informal safety nets, and membership in organizations.

IITA's technologies are the products of its R4D activities. Four types of products originate from this: modern crop varieties, crop and resource management, plant health management, and postharvest practices and technology. Rural people in SSA pursue different livelihood strategies by combining their assets and agricultural technology to achieve their goals, and these are referred to as *livelihood outcomes*. These encompass many of the types of impact of interest in studies of the impact of agricultural technologies on rural livelihoods. The SRLF has been adapted (Fig. 2) to explicitly account for the interactions between livelihood assets and IITA's technologies (Alene et al. 2006a in *IMPACT series*). The adapted framework recognizes the role of R4D in shaping policies, institutions, and processes, instead of research success being fully conditioned by these factors. This has helped to conceptualize how such an approach could not only enhance technology adoption, but also demonstrate development impact that would not have been possible with the simple dissemination of particular technologies. As a framework representing the complex interactions among agricultural research, policy, and livelihoods, it enables a more complete understanding of the impact of new agricultural technologies on rural livelihoods and poverty alleviation.

The framework (Fig. 2) illustrates the important interactions among agricultural technology, assets, policies and institutions, and rural livelihoods. These interactions have implications for research on the adoption and impact of agricultural technologies. Livelihood assets and agricultural technology are combined to pursue an agricultural production-based livelihood, and this yields several livelihood outcomes—more income, improved food security, sustainable use of natural resources, reduced vulnerability, improved gender relations in the household, and better-functioning groups in the community. Assets, technology, and livelihood strategies are conditioned by policies and institutions which influence the initial endowment of assets, the rate and speed of adoption of technology, and the actual livelihood strategy (i.e., agricultural production).

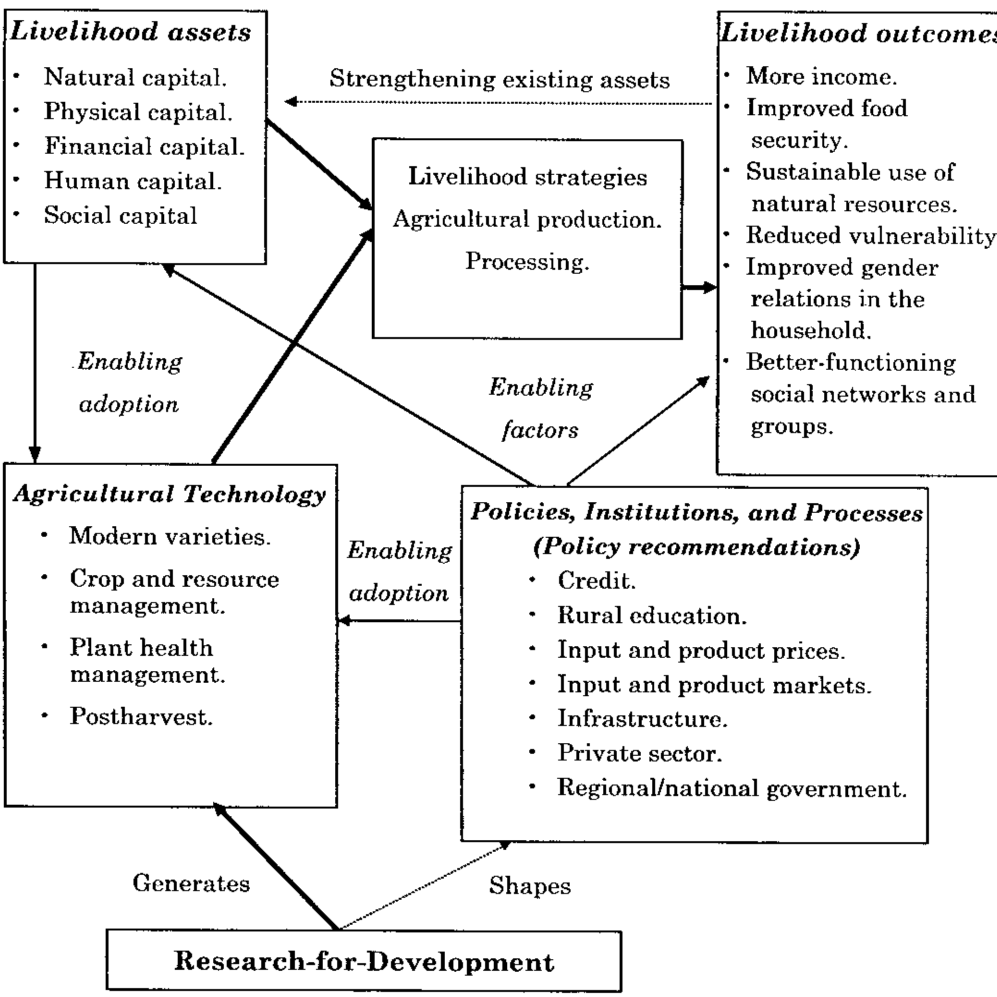

Figure 2. A sustainable livelihoods framework with agricultural technology.

Source: Adapted from DfID 2001.

Given that livelihood outcomes strengthen the five livelihood assets, IA research at IITA has used the adapted framework to monitor changes in key assets following technological intervention in target areas. For example, livelihood outcomes associated with income changes represent changes in financial capital. Outcomes associated with positive changes in the natural resource base represent impacts on natural capital; outcomes associated with changes in the education and health status of children and women or farmers' skills represent impacts on human capital; outcomes associated with changes in intrahousehold gender relations, social networks, and collective action represent impacts on social capital; and outcomes associated with changes in village assets and/or household facilities represent impacts on physical capital. As the impact of new technologies is conditional on adoption by farmers, the issue of the extent and determinants of the adoption of technologies has been as important as their impacts on livelihoods. The advantage of the SRLF is that it provides an integrated adoption and IA framework that looks into the two-way relationships between technology adoption and livelihood assets.

Assets have direct and indirect impacts on livelihood outcomes, such as income and food security, and these strengthen existing levels of assets. The direct impact of assets on these outcomes is through their mere employment in the agricultural production process, with more assets leading to more income and food security. The indirect impact of assets is the impact through the adoption of new technology, with more assets, such as land and livestock, enabling greater adoption of technology and hence leading to more income and food security. The implication of this for the IA of agricultural technologies is that researchers need to account for initial asset endowments to isolate the impact of new technology on rural livelihoods. This means that technology adoption is endogenous and cannot independently have an impact on livelihoods.

Methods

Various appropriate and complementary tools are used to address problems under analysis along the process of IA research. The subsections below highlight some techniques frequently applied for the conduct of IA research at IITA.

Methods for the prioritization of production constraints and opportunities in agricultural systems

The prioritization of constraints to agricultural systems productivity as well as opportunities and farmers' strategies is considered an important activity to improve rural livelihoods at field, farm, and landscape level. An important step in the development of technologies at IITA has thus been the diagnosis of production systems and the identification and prioritization of constraints to agricultural production. This is because the effectiveness and efficiency in developing, adapting, and disseminating improved production technologies depend largely on identifying key production constraints and evaluating farmers' preferred characteristics of these technologies. This has been critical in the process of guiding appropriate technology development. Both quantitative and qualitative methods are applied.

Examples include bioeconomic modelling, econometric analyses (e.g., Almost Ideal Demand Systems models and frontier production functions), and participatory rural appraisal techniques. Often geographic information systems are integrated with traditional methods to prioritize problems at relevant spatial scales, including field, farm, and landscape levels. This process has enabled researchers to assess the complexity of farming systems, to design new approaches to the measurement of crop–livestock integration, to assess farmers' perceptions about cropping systems in general and improved varieties in particular, to evaluate the contribution of key factors in the adoption of production technologies, and to make recommendations for a wider diffusion of these technologies for IITA to achieve its mission of increased food security and reduced poverty. Examples of tools are found in Manyong et al. 2006 in *Agricultural Economics,* Alene and Hassan 2006b in *Journal of Developing Areas*; Endamana et al. 2006 *(IITA)*; Adejobi et al. 2005 in *Journal of Sustainable Development*; Alene et al. 2005 in *Quarterly Journal of International Agriculture*; Okike et al. 2004 in *Journal of African Economies*; Dercon et al. 2004 in *Journal of Community and Applied Social Psychology*; Kormawa et al. 2003 in *African Crop Science Conference Proceedings*; Olarinde 2003 in a *PhD thesis*; Dury et al. 2002 in *Food Quality and Preferences;* Tshiunza et al. 2002 in *Tropicultura*; Manyong et al. 2001 in *Nutrient Cycling in Agroecosystems;* and Ezedinma 2001 in *Journal of Vegetable Crop Production.*

Methods for ex *ante* impact assessment

Ex ante IA research at IITA is undertaken as part of an overall effort to set strategic R4D priorities. This assessment has, recently, involved estimating the potential impacts of alternative research programs, not only on economic surplus in terms of net present value, internal rate of return, or benefit–cost ratio, but also on poverty reduction and sociocultural effects, including attitudes, beliefs, resource distribution, status of women, income distribution, nutritional implications, and institutional implications of the community. The expected returns to investments in alternative R4D programs are estimated in two stages: (1) scenarios are generated with the conditions expected in the future without the proposed research, and (2) the potential impacts of the alternative potential research innovations on economic surplus and on poverty reduction are estimated. The domestic resource cost (DRC) ratios and policy analysis matrix (PAM) are applied to set priorities on technologies and programs. The IFPRI's DREAM model is used to estimate the impacts on economic surplus; partial equilibrium models of household income determination are used to estimate the potential impacts on poverty reduction. Qualitative methods such as scoring techniques are applied to set priorities. A lot of data from a wide range of sources are used to project the potential impacts of a whole range of programs. Methods for *ex ante* impact and priority setting can be found in Alene et al. 2006b at *the Twenty-sixth Triennial Conference of IAAE;* Alene et al. 2006c in *Food Policy;* Manyong et al. 2005 in *Agriculture in Nigeria, published by IITA;* Sanusi et al. 2005 in *European Journal of Scientific Research;* Manyong et al. 2004 in *Book of Abstracts of the Inaugural Conference of African Association of Agricultural Economists (AAAE);* Kiiza et al. 2004 in *Ugandan Journal of Agricultural Sciences;* Muchopa et al. 2004 in *FANRPAN Monograph;* Douthwaite et al. 2002 in *Agricultural Systems;* Kormawa et al. 2002 in *RUSEP Monograph Series No.3.*

Methods for on-farm technology evaluation

On-farm testing of IITA technologies is an important activity aimed at evaluating technologies in a wider range of conditions than is available on-station. Researchers test, with farmers and on their plots, the acceptability and profitability of the technology developed or technologies already available before these are promoted at a larger scale. On-farm economic analysis of new technologies has long been carried out at IITA. Efforts include designing on-farm experiments jointly with biophysical scientists to obtain realistic input–output data for cost–benefit analysis. Analyses conducted on on-station experiments differ from those conducted on-farm because (1) yield response is often biased upward, (2) estimates of labor used by station laborers on small plots are unrepresentative of the farming community, and (3) operations often differ, e.g., when tractors instead of oxen or hoes are used for preparing land. Frontier production functions are often applied to assess the efficiency of cropping systems. On-farm evaluation of technologies by IITA's social scientists has enabled them to better understand the early adoption processes involving the integration of farmers' indigenous knowledge into the scientific knowledge of researchers.

Examples of methods applied in on-farm technology evaluation can be found in Douthwaite et al. 2006 in *Agricultural Systems;* Ojiako 2006 in a *PhD thesis*; Alene et al. 2005 in *Quarterly Journal of International Agriculture;* Okike et al. 2004 in *Journal of African Economies;* Abele et al. 2004 in a *Proceedings by Schriften der GEWISOLA;* Gockowski et al. 2003 in *Food Policy;* Bamire and Manyong 2003 in *Agriculture, Ecosystems, and Environment;* Alene et al. 2006 in *Agricultural Systems;* Alene and Hassan 2003 in *Agricultural Economics Review;* Chianu et al. 2002 in *Experimental Agriculture;* Temple et al. 2002 in *Fruitrop;* Kristjanson et al. 2002 and Tarawali et al. 2002 in *Natural Resources Management in African Agriculture* (a book published by CAB International); Nkamleu 2002 in *Sécheresse;* Ezedinma 2001 in *Journal of Sustainable Agriculture and Environment;* Schulz et al. 2003a, 2003b in *Experimental Agriculture;* and Amegbeto et al. 2003 in *Proceedings of the African Crop Science Conference.*

Methods to assess adoption, farm-level impact, and intrahousehold distribution of benefits

A number of adoption studies have been carried out to measure the extent of adoption of IITA research products, to assess their performance in terms of changes in productivity, income, food security, and farm management induced by the new technology, and to characterize the diffusion process. Household and community surveys are carried out using structured questionnaires, workshops, and focus group discussions to collect information relating to:

- Levels and speed of adoption, and reasons for non-adoption of technology;
- Farmers' perceptions of desirable traits or features of the technology options;
- Farm-level productivity and income gains due to the alleviation of biotic and abiotic constraints;
- Impact on the welfare of the farm household in terms, for example, of the intrahousehold distribution of income, nutrition, and health; and
- Socioeconomic, infrastructural, institutional, and policy constraints hindering technology adoption.

Household-level impact of IITA technologies on productivity, income, and food security are assessed using econometric methods and procedures that explicitly recognize and account for the endogeneity of technology adoption—such as two-stage instrumental variable estimation techniques and endogenous switching regression models. Binary models such as Logit, Probit, and their variants, and Tobit models are commonly used in adoption studies. We use simultaneous equation models to account for endogeneity in technology evaluation. In the case where an improved technology is assumed to have an average impact, the estimation problem arising from the endogeneity of technology adoption is overcome through two-stage instrumental variable estimation.

To assess their levels and speed of adoption over time and project them into the future for *ex ante* IA, we also use logistic functions.

Understanding the intrahousehold impact of interventions on households is an area of human concern that should be considered for the comprehensive assessment of agricultural research impact. Moreover, intrahousehold relations are themselves the subject of IA as a key element of human rights and sustainable livelihoods. IA work at IITA also looks at the impact of new technologies on factors which influence the daily life style and behavioral dimension of the individuals and families, including attitudes toward the policy, perceptions of risk, health, and safety, community cohesion, income distribution, the household decision-making process, family characteristics, friendship networks, and social integration. Bargaining models are some of the analytical tools used to assess intrahousehold distribution of benefits from adoption. Examples of studies applying the above methods can be found in Alene and Manyong 2006a in *Quarterly Journal of International Agriculture;* Alene and Manyong 2006c in *Empirical Economics;* Alene and Manyong 2006d in *Agricultural Economics;* Alene et al. 2006b at *IAAE Conference 2006;* Tipilda et al. 2006 in *Summary proceedings of the Impact Assessment Workshop;* Kristjanson et al. 2005 in *Agricultural Economics;* Alene et al. 2005 in *Quarterly Journal of International Agriculture;* Nkamleu and Manyong 2005 in *Small-scale Forest Economics, Management, and Policy;* Abele et al. (2005) in the *Proceedings of the seventh African Crop Science Conference;* Douthwaite et al. 2005 in *Experimental Agriculture;* Douthwaite et al. 2004 in *Agricultural Systems;* Kormawa et al. 2004 in *Journal of Agriculture and Rural Development in the Tropics and Subtropics;* Nkamleu and Gockowski 2004 at the *Seventy-eighth Agricultural Economics Society Annual Conference;* and Alene and Hassan 2003 in *Agricultural Economics Review.*

Methods to assess *ex post* aggregate economic impact

As an introduction to this subsection, it is worth mentioning that some of the methods described in the above sections are also applied in *ex post* IA.

Assessing the wide-level *ex post* aggregate economic impact of agricultural research requires measuring the combined production and income effects associated with a set of R4D activities. The economic impact can be assessed through what is known as an "efficiency analysis" which compares the cost and the benefits of the project in a systematic manner. The economic IA studies range in scope and depth of evaluation from partial impact studies to a comprehensive assessment of economic impacts. Early IITA work was on partial IA types that looked at the gross economic benefit from crop germ-plasm developed by IITA. Others compared IITA products to best practices in natural resource management. Recent *ex post* economic IA work is of a more comprehensive type, looking beyond mere yield and crop intensities to the wider economic effects of the adoption and spread of new technology. These studies generally estimate the economic benefits produced by research in relation to associated costs, and estimate a rate of return (ROR) to research investments.

The economic surplus model, which is commonly used to assess the impact and distribution effects of a technology or research activity, uses a partial equilibrium approach to estimate the net benefits, the internal rates of returns (IRR), and the distribution of such gains to producers and consumers expressed as changes in producer and consumer surplus. As applied to biological control, the approach typically involves measuring the benefits to society associated with research investments leading to reduced yield losses. Research is supposed to significantly reduce yield losses, thereby resulting in an outward shift in the supply curve. The change is the measure of the social benefit or economic surplus. Biological control is thus essentially conceived of as "maintenance research", where the situation with research (reduced yield loss) is compared with its counterfactual in the absence of research (current yield losses). Maintenance research within this economic surplus approach can be defined as the effort needed to avoid a cost-increasing supply shift which results from changes in the physical, biological, or economic environment. The economic surplus thus generated is shown as the shaded area (Fig. 3), where S_0 is depicted as the supply without maintenance or enhancement research, and S_n as the supply with maintenance and enhancement research. The "without" situation is the supply (S_0) that would have prevailed in the absence of biological control. The Net Present Value (NPV) is estimated by computing the difference between the simulated gross real discounted benefits and the real discounted costs of research and extension.

Examples of publications using such techniques and approaches can be found in Alene et al. 2006b at the *twenty-sixth Triennial Conference of the International Association of Agricultural Economists,* Alene et al. 2005 in *IMPACT* series; Nkamleu 2005 at the *sixth Annual Global Development*

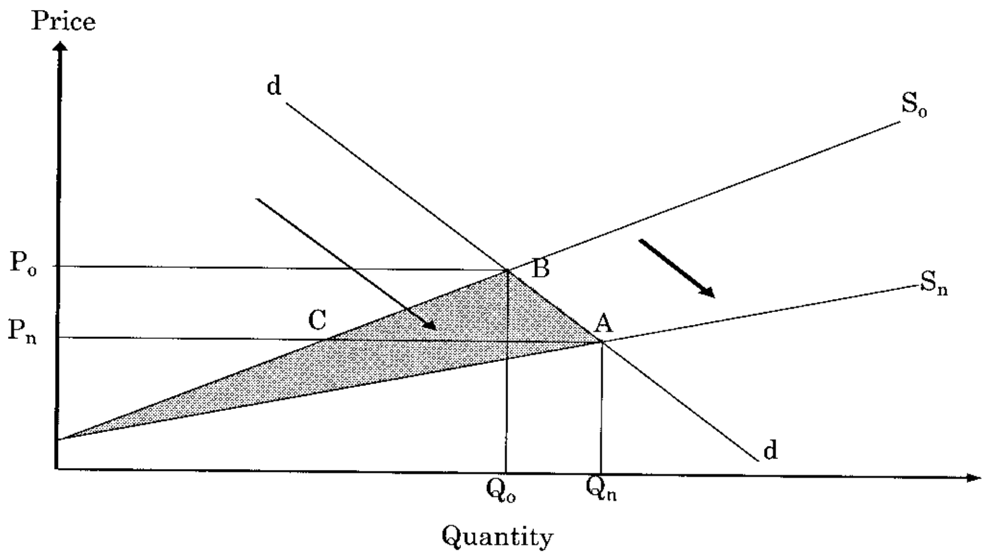

Figure 3. General economic surplus approach adapted to maintenance research.

Source: Adapted from Marasas et al. (2003).

Conference; Douthwaite et al. 2005 in *Experimental Agriculture;* Coulibaly et al. 2004b *(IITA)*; Wakatsuki et al. 2004 at the *ERECON Conference in Japan;* De Groote et al. 2003 in *Ecological Economics;* Dixon et al. 2003 in *Chronica Horticulturae;* Manyong et al. 2003a and Johnson et al. 2003 as chapters in *Crop improvement and its effect on productivity: the impact of international agricultural research,* edited by Evenson and Goffin and published by CAB International; Manyong et al. 2003b in *Proceedings of a regional maize workshop by WECAMAN;* Nweke et al. 2002 in *The Cassava transformation: Africa's best-kept secret,* published by Michigan State University Press, USA; Manyong et al. 2002 in a chapter in *Integrated Nutrients in Sub-Saharan Africa* published by CAB International; and Tshiunza et al. 2001 in *Tropicultura.*

Achievements of Impact Assessment Research

IITA considers IA as a critical component of its R4D activities. It helps to define priorities of research and facilitate resource allocation among programs, guide researchers and those involved in technology transfer to have a better understanding of the way new technologies are assimilated and diffused into farming communities, and shows evidence that IITA technologies are being adopted and that clients benefit from the products of its activities. It is a continuous process whereby benchmark indicators are developed at the onset of programs/projects against which progress could be assessed in the future. Adoption studies are carried out throughout the technology development and dissemination process to ensure that IITA's activities progress towards achieving its mission. *Ex post* impact helps to capture benefits to a wide range of beneficiaries. IITA uses a participatory approach to ensure that the expectations of the users of its products are incorporated into the IA. In an effort to build a favorable impact culture within the Institute, IITA has developed a livelihood-based framework that will help technical and social scientists to have a common vision of the needs and demands of IA in order for them to jointly design and implement it. In addition, IITA has contributed to the development of new approaches and methods in the area of IA research.

The next subsections provide an overview of recent publications along the process of IA research at IITA. A more comprehensive account of achievements over the period 2001–2006—publications and capacity building—is given in Annexes 1–3.

Prioritization of constraints and opportunities in agricultural systems

An important step in the development of technologies at IITA has been the diagnosis of production systems and the identification and prioritization of constraints to agricultural production. It has enabled researchers to assess farmers' perceptions about cropping system in general and improved varieties in particular, to evaluate the contribution of key factors in the adoption of production technologies, and to make recommendations for a wider diffusion of these technologies for IITA to achieve its mission of increased food security and reduced poverty.

Endamana et al. (2006) used a Multinomial Logit model to assess key production constraints to cassava production in Cameroon. They found that land constraints and insufficient supply of planting materials were the main agronomic limitation to the adoption of improved cassava varieties. The reasons why farmers adopted improved varieties were classified in three main groups, including factors linked to cassava production, socioeconomics, and food issues. The majority of farmers reported that high yield was the key factor in adopting a new variety, while 35% of them considered early maturity as the most important characteristic for adoption of a new cultivar. The socioeconomic reasons identified were easy access to outputs markets (13%) and processing facilities and opportunities (4%). The food quality factors identified were the good appearance of the processed products (11%) and the good taste (6%). It was also found that male household heads were more involved in making the choice of improved varieties than female farmers who had a greater interest in marketing cassava and were responsible for the management of sales incomes.

Alene and Hassan (2006a) extended the traditional approach to economic efficiency decomposition into technical and allocative efficiency to overcome the biases associated with the approach under either increasing or decreasing returns to scale. The approach helps to identify opportunities for increasing agricultural production through better use of farm resources and new technology. Application of the model to Ethiopian smallholders and comparison of the results with those obtained from the traditional approach revealed that the results from the new approach were more robust, whereas the traditional approach either overestimates or underestimates the true measures of farmer efficiency.

Manyong et al. (2006) developed an index for measuring effectively the multiple dimensionality of crop–livestock integration (CLI) using the principal components of its most common single measures. They combined GIS-based village-level ecological and market factors with farmers-level resources to estimate parameters of factors affecting CLI, using the derived index as the dependent variable in a Tobit model. This new framework was tested using empirical data from 634 farm households in 11 geo-referenced villages in the Sudan savanna and northern Guinea savanna, Nigeria. Household resources, GIS-derived village-level market factors, and institutional factors also significantly affected CLI. Ecological and institutional factors had most impact on the probability of adoption and use intensities of CLI. The results showed that the incorporation of GIS-derived market factors with household and institutional variables in an econometric model offers new opportunities for assessing patterns of evolution of CLI, comparing results across sites, and targeting recommendation domains objectively.

Amegbeto et al. (2002) applied a Probit model of adoption to identify desirable characteristics of improved yam varieties. They found that yam varietal improvements should target a sweet taste and smooth texture in *amala* (women's preferences) as well as a short cooking time and a non-sticky and elastic texture (men's preferences). The challenge for yam research lies in developing improved varieties that have most of these preferred characteristics. Because all desired agronomic and morphologic characteristics could not be achieved solely through plant breeding, it has been suggested that knowledge of crop management techniques should be disseminated that would enhance the performance of genetic materials developed through research. Similarly, it has been suggested that research should develop processing guidelines for achieving and preserving food quality attributes with the improved yam varieties.

Gold et al. (2002) used farmer participatory evaluation of banana cultivars to identify key desirable characteristics used as selection criteria by farmers in Uganda. They found that bunch size and crop maturity time were the key criteria in the country's most commercial production zones. On the other hand, stand longevity, taste, and maturity time were found to be key factors where banana production is in decline and the sale of bananas is less important.

Ex ante *impact assessment*

In view of declining funds for agricultural research and the need for stronger accountability in recent years, there is now a much greater demand not only for demonstrating the actual impacts of research, but also for maximizing impacts through targeting research benefits to poor people. Emphasis has more recently been given to sharpening the focus of international agricultural research, based on its poverty alleviation impacts. In view of this, especially following recommendations by the last EPMR, *ex ante* IA has been one of the major components of IA research at IITA. With this aim, IITA has adopted a poverty-based approach to setting its R4D priorities (Alene et al. 2006b; 2006c), in addition to the traditional efficiency-based approach, whereby higher overall benefits to producers and consumers are the targets (Manyong et al. 2005; Alene et al. 2006b).

While there is a growing interest in sharpening the focus of agricultural research, there has been no consensus on whether priorities should be based on economic surplus or poverty reduction. This is largely due to the lack of empirical evidence on the nature and magnitude of the efficiency–equity tradeoffs. To contribute to this debate and to develop an approach to be used by IITA, Alene et al. (2006b) examined the issue of whether the poor benefit more from agricultural research that pursues efficiency or equity objectives. This was accomplished by estimating the potential impacts of agricultural research on economic surplus as well as on poverty reduction in Nigeria, identifying strategic priorities according to both efficiency and equity criteria, and examining the nature and magnitude of the efficiency–equity tradeoffs. The results showed that, although introducing a poverty dimension does not result in a significant shift in strategic priorities, greater benefits to the poor, as much as US$155 million, are possible through poverty-based targeting without compromising total benefits (Figs 4, 5). It was noted, however, that efforts made towards the realization of potential benefits to the poor from pursuing either efficiency or equity objectives would be more important than mere targeting of research.

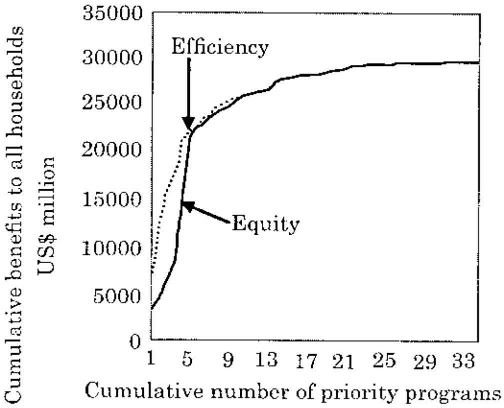

Figure 4. Cumulative benefits to all households from adding research programs according to efficiency and equity criteria.

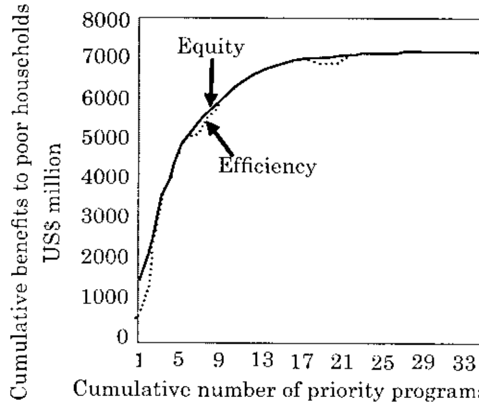

Figure 5. Cumulative benefits to poor households from adding research programs according to efficiency and equity criteria.

Source: Alene et al. (2006b).

Alene et al. (2006c) then used the poverty-based approach to assess strategic research priorities in three major agroecological zones of Nigeria. They measured the potential impacts of alternative commodity research programs on poverty reduction in the dry savanna, moist savanna, and humid forest. Increased agricultural research would bring about positive shifts in the rural income distribution in the three zones (Fig. 6). The results suggested that cowpea, millet, sorghum, groundnut, and livestock research would have greater impact in the dry savanna, whereas maize, yam, and rice hold strong promise for the moist savanna zone. On the other hand, increased cassava and yam research would have a greater impact on poverty in the humid forest and moist savanna zones. Consistent with the greater agricultural diversification in the savanna zones into the production of a range of crops and livestock, the study pointed to the need to work on more crops and livestock in the savanna than in the humid forest.

Manyong et al. (2005) used various analytical methods including GIS, regression analyses, and the IFPRI DREAM model in their book, *Agriculture in Nigeria,* looking at strategies for a rapid development of Nigeria's agriculture. The book includes results from *ex ante* IA to guide strategic investments in the agricultural sector of Nigeria, policy analysis to identify constraints to private sector investment in agriculture, and a review of the performance of the agricultural sector. The study involved a wide range of stakeholders. Many workshops were held to orient and plan for research with universities,

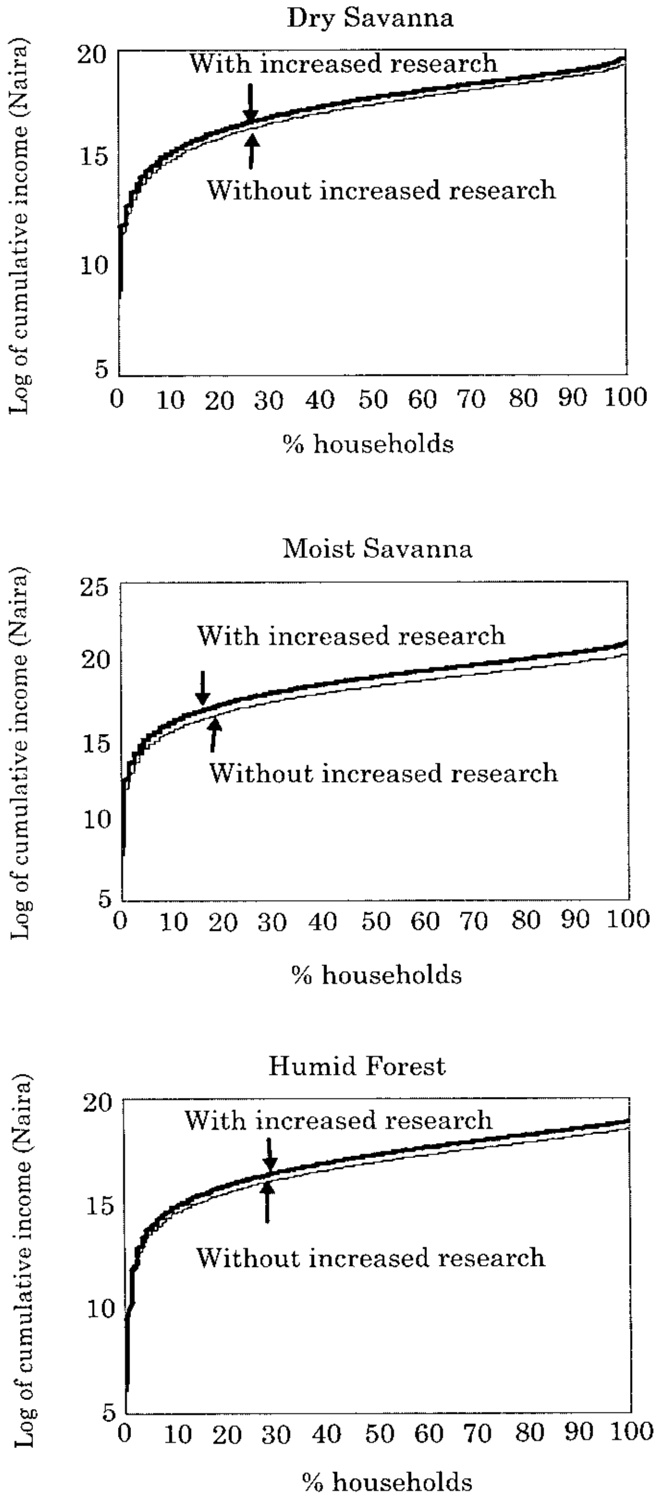

Figure 6. Rural income distribution by agroecological zone in Nigeria with and without increased agricultural research.

Source: Alene et al. (2006c)

the private sector, and policymakers. The book is widely disseminated in the country and outside. Policymakers are using findings from this work to promote a conducive policy environment for the development of commodity subsectors (e.g., the Presidential Initiative on Cassava or the Rice Alliance). Development investors also are targeting their investments on the basis of recommendations from this book (e.g., USAID-funded projects on cassava in southern Nigeria; CIDA project in north-east Nigeria).

Manyong et al. (2004) applied the Disability Adjusted Life Years (DALY) approach to evaluate the potential nutrition and health benefits of biofortified cassava roots in Nigeria. They found that the biofortification of cassava roots would result in substantial annual gains of years of "healthy" life and avert from 1651 up to about 6000 child deaths per year. The main recommendations that came out of the study were that investing in biofortification—a new way of improving naturally the density of micronutrients in staple food for the poor—is highly profitable and that African governments and international investors must make R4D investment in the biofortification of staple crops to improve the standard of living of the people in Nigeria and elsewhere in SSA. Examples of results from *ex ante* IA are given in Table 1.

Adoption and ex post *impact assessment*

Recent examples include the IA of the IITA-led biological control of major pests in SSA, which has far-reaching implications for other continents (e.g., De Groote et al. 2003 in *Ecological Economics;* Neuenschwander 2004 in *Nature;* and Alene et al. 2005 in IITA *IMPACT* series). The second example is in the book, *Crop improvement and its effect on productivity: the impact of international agricultural research,* by Evenson and Gollin (2003) where IITA contributed two chapters on the impact of the Institute's research on cassava for SSA (Johnson et al. 2003) and maize for West and Central Africa (WCA) (Manyong et al. 2003a). Recent publications on the adoption and impact of IITA's technologies, practices, and processes include those on adoption and impact of improved cowpea in northern Nigeria (Alene and Manyong 2006a, 2006b, 2006c, 2006d, 2006e); adoption of pest and disease resistant cassava varieties in Cameroon (Endamana et al. 2006); adoption and impact of cassava varieties in Cameroon (Coulibaly et al. 2004a); adoption and impact of CMD-resistant cassava varieties in western Kenya (Abele et al. 2005); impact of biological control of CGM in Ghana, Bénin, and Nigeria (Coulibaly et al. 2004b); intrahousehold distributional impact of improved cowpea in northern Nigeria (Tipilda et al. 2005); impact of IITA's

Table 1. Examples of evidence on *ex ante* impact of IITA technologies.

Study	Program/ Technology	Country	*Ex ante* impact IRR (%)	NPV (US$ m/ year)	Poverty reduction (%)
Alene et al. (2006b, c)	Cassava	Nigeria	127	333	6.5 (HF)
Alene et al. (2006b, c)	Cowpea	Nigeria	110	107	3.8 (DS)
Alene et al. (2006b, c)	Maize	Nigeria	118	173	6.8 (MS)
Alene et al. (2006b, c)	Yam	Nigeria	131	376	4.8 (MS)
Alene et al. (2006b, c)	Plantain	Nigeria	84	47	–
Alene et al. (2006b, c)	Soybean	Nigeria	56	6	–
Manyong et al. (2004)	Biofortified cassava	Nigeria	186–244	99–295	–

Notes: IRR=Internal Rate of Return; NPV = Net Present Value; DS = Dry savanna; MS = Moist savanna; HF = Humid forest.

Benchmark Area Approach (Douthwaite et al. 2005); and economic gains from maize research in WCA (Manyong et al. 2003b).

Farm-level adoption and impact

A number of case studies have been carried out to document the farm-level adoption and impacts of IITA technologies on income and food security. Alene and Manyong (2006a) assessed the impact of improved cowpea varieties in northern Nigeria using Probit instrumental variable estimation techniques and found that improved cowpea had a positive and highly significant impact on food security, with mere adoption of improved cowpea varieties increasing the household's probability of being food-secure by 32.5%. About 73% of households in the adopting villages cultivated improved cowpea. Adoption of improved cowpea varieties has ensured food security through increased production that translates into both increased incomes and increased food stocks for home consumption. Increased incomes were more a result of the adoption of early-maturing and high-yielding varieties that become available during periods of critical food shortages and hence when cowpea prices are higher on the market.

Using a farm income model that explicitly accounts for endogenous technology adoption, Alene and Manyong (2006b) assessed the adoption and impact of selective and whole package adoption of improved cowpea technologies in northern Nigeria. While 73% adopted the improved seed component of the package, only 21% of the seed adopters adopted the whole package. Adopters who used the complete package obtained an average yield of 1.8 t/ha (compared with 0.8 t/ha from improved seed alone) and income of N65,700/ha (compared with N24,280/ha from improved seed alone). The econometric results showed that adoption of the whole package, but not adoption of selected components, had a significant impact on farm incomes by as much as N26,580/ha. In general, the extent of adoption was significantly influenced by education, credit, extension contact, access to improved seeds, and participation in on-farm technology evaluations.

Alene and Manyong (2006d) evaluated the farmer-to-farmer diffusion of improved cowpea in northern Nigeria in terms of the magnitude and sources of yield variation among adopters. The results revealed important efficiency differences between the lead farmers who had contacts with breeders and the follower farmers who received technology and information from the lead farmers. Differential adoption of the package of seed, insecticide, fertilizer, and recommended cereal–cowpea cropping pattern was found to be responsible for much of the yield variation among adopters. The component largely missing, and hence accounting for much of the yield variation, was the crop management technology relating to the cereal–cowpea cropping pattern. No efficiency variation was attributed to the source of technology and information, such as whether improved cowpea was obtained from breeders or lead farmers. Possible ways of disseminating crop management technological information through the farmer-to-farmer technology diffusion have been recommended to better exploit the yield and profitability potentials of improved cowpea varieties in northern Nigeria.

Intrahousehold IA of improved dual-purpose cowpea varieties in northern Nigeria using a bargaining model revealed that the wives of adopters had access to more income, first from the household head who sold more grain and fodder and then from their own processing of the improved cowpea (Tipilda et al. 2005). Apart from investing supplemented incomes in food security and human capital (the education of children and health care), women also made savings and subsequently invested in petty trading and in the purchase of other assets, such as livestock. They also contributed to their husband's purchase of farm inputs. With increasing savings and petty trading, women were able to form little credit groups with other women. This built up social networks to which they could revert in times of hardship within the family. These networks also promoted collective action and community activities. In the household, not much had changed in terms of the roles played by the men or women. What, however, had changed was that there was less conflict over limited resources and how these were allocated. This was important for the women. They felt they had more independence and there was more stability with fewer incidences of conflict. The women considered indicators such as happy, active, and plump children as the most striking features in improved health care from the adoption of improved cowpea. These perceptions were confirmed by the results on anthropometric indices for children. The results were calculated under three groupings of households—two years of adoption of improved cowpea, three years of adoption, and four years of adoption—and showed that as sustainable adoption occurs over time, differences were being observed between the children of adopters and those of non-adopters.

Abele et al. (2005) used econometric and economic surplus models to measure benefits to consumers and producers of new cassava varieties resistant to Cassava Mosaic Disease (CMD) in western Kenya. A multistage stratified sampling procedure was used to select 350 farmers through random sampling. They found that about 30% of the sample households adopted CMD-resistant varieties and the varieties significantly increased production and marketing potential of cassava compared to the old varieties. High dry-matter content, farm size, access to markets and information significantly influenced adoption, with the most efficient means of dissemination being farmer-to-farmer diffusion. Examples of results from adoption and farm-level impact assessment are given in Table 2.

Aggregate economic impact

Biological control is known to be one of the best environmentally sound techniques to combat devastating pests to major staples in Africa. IITA has been leading this innovative program for years and many publications have been produced in several highly rated scientific journals. Alene et al. (2006a) synthesizes milestones and empirical results from IA research on the IITA-led biological control of major pests in SSA agriculture. The paper provides a useful summary of the economic impacts of the program, which will increase public awareness (including among donors and policymakers) about the relevance of biological control programs to agricultural research. The paper also briefly describes techniques and approaches used to conduct various economic impact studies on biological control.

Coulibaly et al. (2004a) applied an economic surplus model to evaluate the economic impacts of research on host plant resistance in cassava and its diffusion in Cameroon since 1978. The results showed that the new cassava materials performed better by far than the local variety, especially in terms of yield, which

Table 2. Examples of evidence on adoption and farm-level impact of IITA technologies.

Study	Program/ Technology	Country	Adoption (%)	Impact B:C	Impact US$/ha
Alene and Manyong (2006a)	Cowpea package	N. Nigeria	14*	—	385
Alene and Manyong (2006a)	Cowpea seed	N. Nigeria	73*	—	208
Abele et al. (2005)	CMD-resistant cassava	W. Kenya	30	—	428
Johnson et al. (2003)	Cassava improvement	SSA	18	—	—
Manyong et al. (2003b)	Maize improvement	WCA	37	—	—
Wallys (2003)	Soil fertility management	N. Nigeria	—	0.86–1.38	—
Chianu et al. (2002)	Cover cropping	S. Nigeria	—	2.66	—
Chianu et al. (2002)	Alley cropping	S. Nigeria	—	2.07	—
Tshiunza et al. (2002)	Banana varieties	S. Nigeria	58	—	—
Chikoye et al. (2002)	Weed control in cassava	Nigeria, Bénin	—	1.18	—

Notes: B:C=Benefit–Cost ratio; *in adopting villages.

was almost three times the yield of the local variety. The preferred characteristics of the new material are good cooking quality, better taste, easy processing, and shiny color of by-products. Furthermore, the results show that the investment in cassava improvement research has attractive returns because of the substantial benefits accruing to the society. This investment is characterized by a very high NPV for the coastal region of Cameroon as well as for all the country. The other measure of the economic impacts used in the study, the IRR between 1978 (starting date of investment in cassava research) and 2002 was 30%, which is three times higher than the returns to any public investment. The economic impacts measures improved considerably when projections were made at 76% adoption rate for 2010. The authors then concluded that cassava contributes to poverty reduction and welfare in rural areas and recommended that more funds be invested in cassava-related research and technology transfer.

Endamana et al. (2006) used a Multinomial Logit analysis to identify key factors affecting the adoption of cassava varieties resistant to pests and diseases in the coastal forest zones of Cameroon. The results showed that the adoption rate of improved varieties by farmers was high, up to 64%. To stimulate technology scaling-up, the study recommended more exposure of farmers to the new technologies through demonstrations, promotion, and awareness campaigns in all the agroecological zones. The exposure was expected to ensure wider diffusion and a higher contribution of cassava to food security and poverty reduction in the country, with spill-over effects in the Central African region.

Coulibaly et al. (2004b) estimated the net benefits of the biological control of the cassava green mite (CGM) to Bénin, Ghana, and Nigeria. The NPVs of the investments over the period from 1983 to 2020 were very substantial under both pessimistic and optimistic scenarios assumed in the study. Specifically, investments in biological control of CGM have been shown to generate NPVs of US$1.7 billion for Nigeria, US$383 million for Ghana, and US$74 million for Bénin, confirming the high profitability of the classical biological control. There are also clear ecological benefits that have not been incorporated into the analyses. Overall, the results have demonstrated that the biological control program has generated substantial net benefits to cassava producers and consumers in SSA.

Douthwaite et al. (2005) evaluated the Benchmark Area Approach (BAA) pioneered by IITA. The BAA was evaluated against nine good practice criteria for ecoregional research and it was found that the approach is delivering, or has the potential to deliver, on all nine. Many of the lessons learnt from this evaluation will be relevant to current and future attempts to undertake coordinated multilocational R4D. This study was conducted by IITA in collaboration with experts from FAO and ICRISAT, with a large African coverage and implications. Unlike conventional *ex post* IA studies, this research applied innovative techniques to assess the BAA. Lessons from the BAA are being incorporated in the development of the new sub-Saharan Africa Challenge Programs and the new concept about Development Domains in targeting agricultural research interventions. Examples of results from aggregate adoption and *ex post* IA are given in Table 3.

Capacity building

Over the period under review, there have been important achievements in terms of capacity building in the broad area of IA through postgraduate training (MSc and PhD), internship of graduate students, and group training of NARS partners for IA research. This is in addition to hands-on training of collaborators, as shown in the co-authorship of most of the publications in Annex 1. On postgraduate training, 12 PhD and 13 MSc students completed their studies (Annex 2). In total, about 283 collaborators participated in group training (Annex 3).

Communication of results from impact assessment research

The traditional channels of communicating results from research have been used, namely, publications of research papers in peer-reviewed journals, chapters of books, books, papers presented at conferences and those in the proceedings of conferences (Annex 1). IITA continues to publish the very attractive *IMPACT* series, which summarizes findings from IA research. A total of 4 *IMPACT* documents have been published since 2001.

Table 3. Examples of evidence on aggregate adoption and impact of IITA technologies.

Study	Program/ Technology	Country	Adoption (%)	*Ex post* impact IRR (%)	B:C	NPV (US$ m/year)
Alene et al. (2005)	BC cassava mealybug	SSA	—	—	94–800:1	110–940
Johnson et al. (2003)	Cassava improvement	SSA	18	9–22	—	328*
Manyong et al. (2003)	Maize improvement	WCA	37	—	—	490*
De Groote et al. (2003)	BC water hyacinth	Bénin	—	—	124:1	30
Coulibaly et al. (2004b)	BC cassava green mite	Bénin	—	101	—	74
Coulibaly et al. (2004b)	BC cassava green mite	Ghana	—	111	—	383
Coulibaly et al. (2004b)	BC cassava green mite	Nigeria	—	125	—	1688
Bokonon-Ganta et al. (2002)	BC mango mealybug	Bénin	—	—	145:1	26

Notes: BC=Biological control; B:C=Benefit–Cost ratio; IRR=Internal Rate of Return; NPV=Net Present Value. *Gross economic benefit.

The IA team successfully organized two mini-symposia—one during the twenty-fifth Conference in Durban, South Africa (16–22 August 2003) and another during the twenty-sixth Conference in Brisbane, Australia (12–18 August 2006)—of the International Association of Agricultural Economists (IAAE). The theme of the first mini-symposium was on globalization (Title: *Market Research for the Development of Commercialized Agriculture in Sub-Saharan Africa*) while that of the second was on research on impact (Title: *Assessing the Impact of Agricultural Research on Rural Livelihoods in Developing Countries: Approaches, Challenges, and Results*). The two symposia were well attended and contributed significantly to the visibility of research on IA at IITA. In addition, the IITA scientists took part in and presented papers at the inaugural symposium of the African Association of Agricultural Economists (AAAE) in Nairobi, Kenya (6–8 December 2004).

Contributions to International Public Goods

The IITA research has made some noticeable contributions to the development or refinement of methods and approaches used in IA research and also to capacity building. Those are international public goods (IPGs) and the most significant are summarized.

The new framework for conceptualizing IA and promoting impact culture in agricultural research (Alene et al. 2006a) provides theoretical and practical guidance for the conduct of IA research.

The research by Manyong et al. (2006) led to the development of an innovative approach to measuring the multiple dimensionality of CLI. This framework contributes to a better understanding of processes in the evolution and factors that influence CLI for a better management of natural resources. The framework derives a CLI index using the principal components of its most common single measures; it develops GIS-based village-level ecological and market factors, and it estimates parameters of factors affecting CLI using the derived index as the dependent variable in a Tobit model. A comparison with results from more common methods of running independent models for individual indicators of CLI showed that this new framework is an effective way of reducing the multiple dimensionality of CLI to gain quicker, well focused knowledge of the processes of agricultural intensification.

Alene and Manyong (2006a) addressed the issue of endogeneity in technology adoption using a farm income model. The authors demonstrated that a two-stage instrumental variable estimation ensures that observed impacts are due to the technology as opposed to some underlying factors that determined technology adoption. The first stage is a Probit or Tobit analysis of technology adoption to identify the factors that explain adoption and to calculate for each household the likelihood or intensity of adoption, given the values of all the explanatory variables. These predicted probabilities or intensities of adoption replace the unobserved variables and then are treated as if they were the known values of the unobserved variables. Appropriate instruments—variables that do not have a direct impact on livelihood outcomes, except through technology adoption—are used to identify the technology adoption equation. Alene and Manyong (2006a; 2006b) used rich data on the characteristics of improved cowpea varieties in northern Nigeria as instruments and over-identifying restriction tests were employed to test the validity of these instruments.

Alene and Hassan (2006a) developed a model of farmer efficiency decomposition into technical and allocative efficiency, which is an important methodological contribution. The traditional approach has been extended to overcome the biases associated with the approach under either increasing or decreasing returns to scale. The extended approach helps to identify, based on realistic opportunities, appropriate policies and strategies for increasing agricultural production through better use of farm resources and new technology.

Douthwaite et al. (2004) developed a new approach about impact pathway evaluation for achieving and attributing impact in complex systems. They developed a two-stage approach to monitoring, evaluation, and IA—referred to as *impact pathway evaluation*. In the first stage, a research project develops an impact pathway for itself, which is an explicit theory or model of how the project sees itself achieving impact. The project then uses the impact pathway to guide project management in complex environments. The second stage is an *ex post* IA some time after the project has finished, in which the project's wider benefits are independently assessed.

Training of postgraduate students has also been another achievement on IPGs.

Strategies for the future

Impact culture

The new framework for IA research (Alene et al. 2006a), which has been proposed to create an impact culture at IITA through greater involvement of biophysical scientists, will provide an opportunity to carry out increased IA research aimed at documenting adoption and impact of IITA technology. The framework aims to make IA an integral part of the research process at IITA by institutionalizing an appropriate data system. This ensures that the information generated by research is available in a systematic and timely manner and is retained for present and future uses. To operationalize the data system, data sheets for each stage of the IA process are developed to guide researchers in gathering relevant and adequate data relating to each agricultural technology. The new IITA Medium Term Plan (MTP) also calls for greater integration of disciplines and researchers and provides an opportunity for increased IA research at IITA. *Ex ante* IA and *ex post* IA, as well as priority setting tools, are integrated in all commodity-based projects in the 2007–2009 MTP. The respective activities include the *ex ante* identification of market opportunities and of constraints to the respective agri-food chains in order to define entry points for IITA's R4D. *Ex post* IA is also an integral part of the new MTP projects. In two cross-cutting MTP projects, *Agriculture and Health* and *Opportunities and Threats,* IA is the central point of research. In *Agriculture and Health,* anthropology will be applied to assess intrahousehold nutrition requirements and distribution of food, whereas in *Opportunities and Threats,* there is a strong focus on *ex ante* identification of biotic and abiotic stresses, economic opportunities, and constraints to agricultural production in SSA, as well as the identification of novel postharvest technologies and industries to increase the efficiency and value added in the respective commodity chains.

IA research should also benefit from the new Strategic Analysis and Knowledge Support Systems (SAKSS) initiative that will make disaggregated and cross-country data available on a range of biophysical and socio-economic variables in WCA.

Major initiatives and challenges

Assessing opportunities and threats

Agricultural production in SSA takes place in an ever-changing environment and so does agricultural research. On the one hand, numerous opportunities are arising from economic growth and increasing trade relationships. Income increases drive the demand for high-quality raw and processed products. On the other hand, pests, diseases, and drought impose a continuous threat to food security and livelihoods. As a research institute operating in this dynamic environment, IITA will need to update its research priorities, based on regular assessment of the opportunities and threats. As stated above, this will require a lot of *ex ante* IA research aimed at identifying and quantifying the opportunities and threats, such as high value crops, market opportunities, national policies deregulation, and climate change.

Adoption and impact of nontraditional R4D products

As the scope of IITA's R4D expands, the scope of IA research will also expand. Future IA research will thus include the adoption and impact of nontraditional research products, such as processing technologies, products development, market information, and agricultural policies. To this end, the IA methods and frameworks will be refined to accommodate new products, knowledge, and processes.

Economics of genetic resources conservation

A study of the impact of IITA's genebank is already underway and more time and resources will be devoted toward its realization. This study aims to assess the economic impact of the *ex situ* conservation and distribution of germplasm of IITA mandate crops by the Institute's genebank. The economic valuation will be based on the assessment of benefits generated by the use of conserved genetic resources mainly in breeding programs for improved food crop varieties.

Economics of seed systems

Seed systems are important catalysts in technology development and dissemination. In Africa, especially in WCA, one of the major constraints to the adoption of improved varieties and hence to achieving greater impact on target beneficiaries is the lack of viable seed systems. There is now a new IITA–CIMMYT initiative to evaluate the organization and performance of maize seed production and distribution schemes—small-scale community schemes as well as large-scale seed enterprises—in WCA. The objective is to identify critical areas of intervention to promote the production, postharvest processing, and marketing of improved seed. This will require a broad social science perspective to understand the incentives and constraints that participants face and to interpret the "rules of the game" that must be negotiated.

Activities related to CGIAR Challenge Program

The Challenge Program (CP) recently approved by CGIAR on biofortification involves breeding nutritionally enhanced plants containing elevated levels of iron, protein, vitamin A, and other essential micronutrients lacking in the diets of the poor. There are ongoing efforts to develop cassava and maize varieties with elevated levels of beta carotene (metabolized by humans into vitamin A). Manyong et al. (2004) found significant potential impacts of biofortified cassava in Nigeria, confirming the feasibility of investing in biofortification. However, further research will be needed to assess farmers' varietal preferences, based on the agronomic and consumption characteristics of the nutritious varieties. Breeders will need this information to develop nutritionally enhanced varieties that farmers will be willing to grow and eat.

The SSA Challenge Programme of the Forum for Agricultural Research in Africa (FARA) addresses innovation platforms and issues related to partnership to improve the efficiency and impact of agricultural research. Assessing the impact (*ex ante* or *ex post*) requires innovative approaches.

Other challenges of impact assessment research

The IA team at IITA will face emerging challenges, such as the economics of biotechnology and climate change, while at the same time addressing existing gaps in IA research, such as measuring the spill-over effects and attribution problems.

New paradigms brought about by the new institutional economy will result into new challenges for more institutional analysis and evaluation of soft sciences and processes.

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Ezedinma, C.I. and O.C. Korie.	2001	Migrant remittances and rural development in Imo State, Nigeria. *International Journal of Agriculture and Rural Development* 2: 87–96.
Ezedinma, C.I. and N.N. Oti.	2001	Socioeconomic issues in the development of cassava processing technologies in Nigeria. *Journal of Sustainable Agriculture and Environment* 3(1): 118–125.
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Manyong, V.M., K.O. Makinde, N. Sanginga, B. Vanlauwe, and J. Diels.	2001	Fertilizer use and definition of farmer domains for impact-oriented research in the northern Guinea savanna of Nigeria. *Nutrient Cycling in Agroecosystems* 59: 129–141.
Nkamleu, G.B.	2001	Aspects socio-économiques de l'utilisation des pesticides par les producteurs de café-cacao au Cameroun. *In* L'avenir des cultures pérennes, investissement et durabilité en zones tropicales humides. Conférence internationale sur l'avenir des cultures pérennes, 5–9 novembre 2001, Yamoussoukro, Côte d'Ivoire.
Okike, I., M.A. Jabbar, V.M. Manyong, J.W. Smith, J.A. Akinwumi, and S.K. Ehui.	2001	Agricultural intensification and efficiency in the West African savannas: evidence from northern Nigeria. Socioeconomics and policy research working paper No. 33. ILRI, Nairobi; IITA, and UI, Ibadan, Nigeria.
Olaniyan, G.O., V.M. Manyong, and B. Oyewole.	2001	The dynamics of the root and tuber cropping systems in the middle belt of Nigeria. Pages 75–82 *in* Root Crops in the 21st Century. Proceedings of the seventh Triennial Symposium of the International Society for Tropical Root Crops – Africa Branch (ISTRC– AB). Compiled by M.O. Akoroda and J.M. Ngeve. 11–17 October 1998. Centre International des Conférences, Cotonou, Bénin.

Peters, M., P. Horne, A. Schmidt, F. Holmann, P.C. Kerridge, S.A. Tarawali, R. Schultze- Kraft, C. Lascano, P. Argel, W. Stur, S. Fujisaka, K. Muller-Samann, and C. Wortmann.	2001	The role of forages in reducing poverty and degradation of natural resources in tropical production systems. AgREN Network Paper No. 117.
Tshiunza, M, J. Lemchi, C. Ezedinma, and A. Tenkouano.	2001	Performance of public and non-public organizations in the dissemination of cooking bananas in Nigeria. *Tropicultura* 19 (4): 206–209.

Annex 2

Capacity building—Postgraduate training (2001–2006)

A. Completed PhD theses

Name	Year	Research topic and University	Country
Ojiako, I.A.	2006	Economic evaluation of adoption of improved soybean production and utilization technologies in Kaduna and Kano States, Nigeria. Department of Agricultural Economics, University of Ibadan, Nigeria.	Nigeria
Adejobi, D.	2004	Rural livelihoods, poverty, and food systems in Nigeria. IITA fellowship. University of Ibadan, Nigeria.	Nigeria
Ibana, I.	2004	Economic analysis of weed management systems and food security in Nigeria. University of Ibadan, Nigeria.	Nigeria
Olarinde, L.O.	2004	Management of maize production risks as it affects decisions to adopt hybrid maize varieties. University of Ibadan, Nigeria.	Nigeria
Brown, D.	2003	Economic determinants of land-use decisions along the forest margins of southern Cameroon (ASB). Cornell University, USA.	Cameroon
Nomo Bidzanga, E.	2003	The complex cocoa agroforests of southern Cameroon and farmers' local knowledge. University of Wales, Bangor, UK	Cameroon

Obamiro, E.	2003	Poverty, nutritional status, and the determinants of rural households' food demand in Nigeria. University of Hohenheim, Stuttgart, Germany.	Nigeria
Shu, R.	2003	The impact of cassava commercialization on women's welfare. University of Wageningen, The Netherlands.	Cameroon
Akouegon, G.E.	2002	Using feedback to refine legume innovations: assessment of farmers' reaction experimenting with herbaceous legumes as a strategy to promote legume utilization in West Africa. University of Hohenheim, Stuttgart, Germany.	Bénin
Fregene, B. T.	2002	Poverty assessment of fishing communities of Lagos State, Nigeria. University of Ibadan, Nigeria.	Nigeria
Manirakiza, D.	2002	The determinants of the demand for non-timber forest products in Yaoundé: the example of *andok* (*Irvingia* sp.) and *janssang* (*Ricinodendron heudelotii*). University of Yaoundé, Cameroon.	Cameroon
Tabi, F.	2002	The development of a land information system for agrotechnology transfer. University of Ibadan, Nigeria.	Nigeria

B. Completed MSc theses

Name	Year	Research topic and University	Country
Djinadou Igué, K.A.	2005	Analyse de l'influence du genre sur la diffusion des nouvelles technologies du niébé par les méthodes du Farmer Field School. FSA/UAC, Bénin.	Bénin
Gbaguidi, B.J.	2005	Analyse de performance du champ école paysan dans l'utilisation et la diffusion des technologies par les producteurs : cas du Projet Niébé pour l'Afrique au Bénin. FSA/UAC, Bénin.	Bénin
Owoeye, L.	2004	Evaluation of selected legumes for sustainable South African weed ecology/soil fertility/livestock management interactions in crop–livestock systems of the moist savanna of sub-Saharan Africa. University of Ibadan, Nigeria.	Nigeria
Ugbabe, O.	2004	BNMS economic analysis of the best bet balanced nutrient management systems in northern Nigeria. Ahmadu Bello University, Zaria, Nigeria.	Nigeria
Yanguba, A.	2004	Self-diffusion, adoption, and impact of extra-early maize varieties in the Sudan savanna ecological zone, northern Nigeria. University of Ibadan, Nigeria.	Sierra Leone
Adeoti, R.	2003	Profitability and competitiveness of cowpea production in West Africa: a comparative analysis between coastal and landlocked Sahelian countries. Université de Bénin.	Nigeria

Ajero, J.	2003	Indigenous seed production and distribution strategies in northern Guinea savanna of Nigeria: opportunities for herbaceous legumes. Federal University of Technology, Owerri, Nigeria.	Nigeria
Maboudou Alidou, G.	2003	Socioeconomic determinants of maize postharvest systems in Guinea savanna. University of Ibadan, Nigeria.	Bénin
Wallys, K.	2003	Economic analysis of promising balanced nutrient management systems in northern Nigeria. Katholieke Universiteit Leuven, Leuven, Belgium.	Belgium
Ironkwe, A.G.	2002	Women participation in the transfer of yam minisett technology in South-eastern Nigeria. Michael Okpara University of Agriculture, Nigeria.	Nigeria
Oyederu, O.	2002	Development, adaptation, and adoption of *Striga* and *Imperata* management options in Nigeria. Ogun State University, Nigeria.	Nigeria

Annex 3

Capacity building—Group training of NARS (2001–2006)

Place	Date	No. of Partic-ipants	Course requested by NARS and taught by IITA	Sponsors
Kisumu Kenya	15–18 May 2006	16	Perception study on *Striga* control using IR–maize in western Kenya: GIS field measurements and data collection methodology workshop.	AATF/ Ministry of Agriculture of Western and Nyanza provinces
Bohicon Bénin	14–16 November 2005	40	*Ex ante* and *ex post* Impact assessment/ Econometrics.	INRAB, Danish project (phase 2)
Kakamega Kenya	2–6 October 2005	31	Baseline study on *Striga* control using IR-maize in western Kenya: livelihoods analysis and sampling techniques methodology workshop.	AATF/ Ministry of Agriculture of Western and Nyanza provinces
Djougou Bénin	1–5 June 2005	17	Impact assessment of agricultural technologies, extension, micro-finances and markets on food security, poverty reduction, and environment in sub-Saharan Africa.	IFAD investment PDRT (Root and Tuber Development Project)

IITA-Cotonou Bénin	13–24 September 2004	6	Graduate students (MSc) in Agricultural Economics of University of Abomey-Calavi on different methods of prioritization (scoring, checklist, congruence and cost–benefit ratio), priority settings, measurement of poverty reduction indicators (demographic, economic, social) and their dynamic.	IITA
Maputo Mozambique (regional)	19–20 August 2004	36	Agricultural policy priorities for improving rural livelihoods in southern Africa: regional synthesis workshop.	USAID, IITA, and Mondlane Edwardo University
Maputo Mozambique	4 August 2004	24	Defining agricultural policy priorities: national workshop.	USAID and Mondlane Edwardo University
Lusaka Zambia	7–9 July 2004	34	Defining agricultural policy priorities: national workshop.	USAID and Department of Agricultural Economics, University of Lusaka
Lilongwe Malawi	1–3 July 2004	20	Defining agricultural policy priorities: national workshop.	USAID and Bunda College
Dar es Salaam Tanzania	28–30 June 2004	43	Defining agricultural policy priorities: national workshop.	USAID and ESRF

Johannesburg South Africa (regional)	19–20 January 2004	16	Agricultural policy priorities for improving rural livelihoods in southern Africa: regional methodology workshop.	USAID Southern Africa Regional Office
Ségou Mali	29 June–04 July 2003	45	Impact Assessment of Agricultural Technologies on Food Security, Food Safety, Poverty Reduction, Microfinance and Environment in sub-Saharan Africa.	USAID-Mali, Ministry of Agriculture, Livestock and Fisheries
Bohicon Bénin	31 March–04 April 2003	24	Training of researchers of Programme d'Analyse des Politiques Agricoles (PAPA) and Programme de Tecnologies Agro-Alimentaires (PTAA) of INRAB on financial and economic analysis tools for evaluation of postharvest technologies in Bénin.	INRAB, Danish project
Bunso Ghana	11–13 March 2003	18	Training course in socio-economics for Biological Scientists.	IFAD investment project RTIP
Ségou Mali	15–19 July 2002	35	Monitoring and Evaluation/Impact assessment of research: indicators and measurement	IFAD investment projects of Mali
Conakry Guinea	14–20 March 2002	30	Impact assessment of agricultural technologies on food security, poverty reduction and environment protection in sub-Saharan Africa	SDC

Bohicon Bénin	6–11 January 2002	13	Impact Assessment of Agricultural Technologies on Food Security, Food Safety, Poverty Reduction, and Environment in sub-Saharan Africa	INRAB, DANIIDA, IITA
Kpalimè Tovè Togo	17–21 December 2001	35	Monitoring and Evaluation/Impact assessment of research: Indicators and measurement	SDC, IITA
Parakou Bénin (regional)	29–3 November 2001	13	Modeling Technology Adoption and Assessing Economic Viability and Impacts of Yam Technologies: Methodology Workshop	IFAD - IITA
Parakou Bénin (regional)	3–10 February 2001	20	Impact assessment of technological change on food security, poverty reduction and environment protection	PRONAF-IITA /IFAD

About IITA

The International Institute of Tropical Agriculture (IITA) is an Africa-based international research-for-development organization, established in 1967, and governed by a board of trustees. Our vision is to be Africa's leading research partner in finding solutions for hunger and poverty. We have more than 100 international scientists based in various IITA stations across Africa. This network of scientists is dedicated to the development of technologies that reduce producer and consumer risk, increase local production, and generate wealth. We are supported primarily by the Consultative Group for International Agricultural Research (CGIAR, www.cgiar.org).

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This is one of a series of publications about the impact of IITA's work. The publications describe impact studies, conducted by multidisciplinary teams, which aim ultimately to confirm that IITA's research fulfils its mission to enhance the food security, income, and well-being of resource-poor people in sub-Saharan Africa.

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